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# Origins of the Human Mind

Course Guidebook

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University of California, Berkeley



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## **Stephen P. Hinshaw, Ph.D.**

Professor of Psychology  
and Chair of the Department of Psychology  
University of California, Berkeley

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**P**rofessor Stephen P. Hinshaw is Professor and Chair of the Department of Psychology at the University of California, Berkeley. After receiving his A.B. summa cum laude from Harvard University in 1974, he directed day school and residential programs for children with developmental disabilities for 3 years. In 1983, he received his Ph.D. in Clinical Psychology from the University of California, Los Angeles; in 1980, he received the UCLA alumni association's Distinguished Scholar Award, which honors the university's outstanding graduate student.

Professor Hinshaw was a clinical psychology intern at UCLA's Neuropsychiatric Institute from 1981 to 1982. He then was a postdoctoral fellow at the Langley Porter Psychiatric Institute of the University of California, San Francisco, from 1983 to 1985, where he received the Robert E. Harris Award. He taught in the Psychology Department at UCLA from 1986 to 1990 and joined the UC Berkeley faculty in 1990. He received the Distinguished Teaching Award from UC Berkeley's Division of Social Sciences, College of Letters and Science, in 2001.

Professor Hinshaw's work focuses on developmental psychopathology, with particular emphases on peer and family relationships in children with externalizing disorders, neuropsychological risk factors for and correlates of psychopathology, comparisons and combinations of pharmacological and psychological interventions for children with attention deficit/hyperactivity disorder (ADHD), assessment and evaluation, conceptual and definitional issues in the field, and the stigmatization of mental illness. For more than 25 years, he has directed summer research camps for, and conducted longitudinal studies of, boys (and more recently, girls) with ADHD and associated disorders.

Professor Hinshaw is the editor of *Psychological Bulletin*, the most cited journal in the entire field of psychology. He is also an associate editor of the journal *Development and Psychopathology* and has authored more than 200 articles, chapters, and reviews on child psychopathology. His first book was *Attention Deficits and Hyperactivity in Children* (Sage, 1994). His other books include *The Years of Silence Are Past: My Father's Life with Bipolar Disorder* (Cambridge University Press, 2002) and *The Mark of Shame: Stigma of Mental Illness and an Agenda for Change* (Oxford University Press, 2007). Professor Hinshaw's edited books include *Breaking the Silence: Mental Health Professionals Disclose Their Personal and Family Experiences of Mental Illness* (Oxford University Press, 2008) and *Child and Adolescent Psychopathology* (Wiley, 2008), coedited with Theodore P. Beauchaine. His newest book is *The Triple Bind: Saving Our Teenage Girls from Today's Pressures* (Random House/Ballantine, 2009), coauthored with Rachel Kranz.

In support of his research efforts, Professor Hinshaw has received more than \$13 million in grants from the National Institute of Mental Health and other federal agencies. He is past president of the International Society for Research in Child and Adolescent Psychopathology and Division 53 of the American Psychological Association (Society for Clinical Child and Adolescent Psychology). He is also a Fellow of the Association For Psychological Science, the American Psychological Association, and the American Association for the Advancement of Science.

Professor Hinshaw lives in Berkeley, California, with his wife, Kelly Campbell Hinshaw, an art educator and children's book author. They have 3 sons. ■

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# Origins of the Human Mind

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## Scope:

**A**mong the animal kingdom, the human mind is the only one to reflect on its own nature and development. Our minds are unsurpassed in flexibility, imagination, creativity, and narrative ability, but they are also subject to distortions and biases as well as the potential for highly impairing mental disturbances. Modern neuroscience has shifted the view of our minds—as inextricably linked to complex brain chemistry rather than the products of spirits or supernatural forces—with major implications for how we perceive ourselves as a species. The emergence of our minds from non-human minds, their development across each human lifespan and their linkages with brain functions, whether they are modular or general purpose in nature, how they are shaped by contextual factors, and how they can both flourish and “go wrong”: These are the core issues addressed in this course.

A number of perplexing questions continue to be addressed by philosophers, biologists, psychologists, and neuroscientists: How have the unique aspects of the human brain and human mind evolved from those of mammals and primates? Have they continued to develop across our species’ time on Earth? What are the implications of natural selection and modern brain science for understanding our minds and ourselves? How have humans viewed their own minds throughout history? What roles do temperament, attachments with caregivers, family childrearing styles, neighborhoods, and culture play in forming each of our behavioral and emotional styles? In what ways can the mind go awry as we experience trauma or suffer from mental disturbance? Are we fundamentally prosocial or aggressive as a species? Can we create a more humane view of all individuals by acknowledging our diversity and using our narrative abilities to humanize our peers? These questions and more are addressed.

Modern neuroscience informs us that we are born with over 100 billion neurons, meaning that several thousand new neurons are created during each and every second of our 40 weeks in the womb. Across the first years of

life, these neurons develop elaborate networks of interconnection with one another, linking at synapses. Through processes of pruning, neurons that do not form such connections are lost, creating a more efficient mind. Genes are clearly involved in shaping neural connections and in pruning, but life experiences activate genes and forge how and where neurons interconnect. In short, brain development is marked by plasticity—and evolution clearly favored human minds with the ability to be molded by experience. Because our brains and minds are involved in an elaborate interplay of biology and contextual forces, we must traverse multiple levels of analysis, from genes to families and cultures, to gain deep understanding.

An introductory lecture provides the course framework, emphasizing spirit-based, naturalistic, and humanistic models for understanding the mind. Next, we cover the structure and function of the brain, with much attention given to principles of brain development. Evolution is the next focus, followed by core psychological views of the mind: psychodynamic theory, from Freud to modern psychoanalytic concepts, and social learning theory from Pavlov, Skinner, and Watson to the modern cognitive behaviorists. The progression across evolutionary development from instinct to learning is featured, along with the modularity of the mind's functioning and information about the cognitive revolution and emotion revolution of the last century. We next consider recent microevolutionary investigations, which emphasize that the core difference between human brains and those of primates is not sheer size but the number of neurons in the cortex and the massive, high-speed interconnections across brain regions. Human evolution favored brains with great responsiveness to our complex social environments.

Individual development is covered in the next set of lectures, from the earliest years of childhood through adolescence, adulthood, and aging. Key topics include temperament, attachment, and the contextual factors of families, neighborhoods, and culture. Important questions include whether adolescent minds are inevitably rebellious and whether the advancing years signal inevitable decline versus the development of wisdom. Subsequent lectures deal with gender and the mind, risk and protective factors, and interactions between biology and experience.

We then address the building blocks of life—genes and DNA—and the concepts of heritability and gene-environment interplay to explain individual differences in human minds. Because recent science emphasizes that genes and environments work in concert in incredible ways, the dichotomy of nature versus nurture is sorely out of date. We then discuss how minds are altered by trauma and mental illness. Indeed, when positive features of the mind are thwarted, mental disorders—such as post-traumatic reactions, schizophrenia, mood disorders, disruptions of attention and regulation, and autism—may result. Such conditions inform us about the mind’s ultimate potential. From an evolutionary perspective it is not deviant genes but rather mismatches between our genetic heritage and the nature of our current human environments that underlie disordered functioning.

Considered next is how evolution has shaped our human tendencies to be religious, to show aggression versus prosocial behavior, and to stigmatize fellow humans who are not members of our primary ingroups. Personal and family narratives, which exemplify the mythic skills of all humans, offer a key means of humanizing one another. The final lecture includes advances in the study of the human brain and mind, with implications for renewed self-understanding.

Spanning historical models, evolutionary and microevolutionary forces, links between biology and experience, the role of development, the arena of mental disturbance, and the potential for emergence of a more humane view of the varieties of human behavior, this course provides a tour of fundamental questions in psychology, psychiatry, evolution, neuroscience, narrative, and ethics. ■

# Brains and Minds, Evolution and Development

## Lecture 1

**Human brains, of course, are the 3-pound masses of soft tissue inside our skulls; as we'll learn, they're incredibly complex. But what are our minds?**

**T**his course examines how evolutionary forces shaped the human brain and the mind it creates, and how each brain and mind develop across a human lifespan. In order to link brains with minds and evolution with individual development, we must address many levels of analysis—spanning genes, products of genes, structures and chemicals of the brain, brain regions and lobes, and the environmental forces that shape our minds and brains.

How did the human brain, and mind, evolve from those of other mammals and primates across hundreds of millions of years, and how did modern humans gain an artistic, language-related, and self-reflective power across the past 150,000 years?

A timeline of the past several hundred million years reflects the development of mammals, then primates, with ever more complex brains, including the cortex in mammals. A timeline of the past 2.5 million years reveals no progression or intentional teaching of innovations across the species' existence—until *Homo sapiens*. A timeline of the past 150,000 years shows the presence of a remarkable compression of the growth of human abilities and the human mind within the past 30,000–40,000 years, leading to speculation that cultural evolution, rather than natural selection, has shaped the human mind.

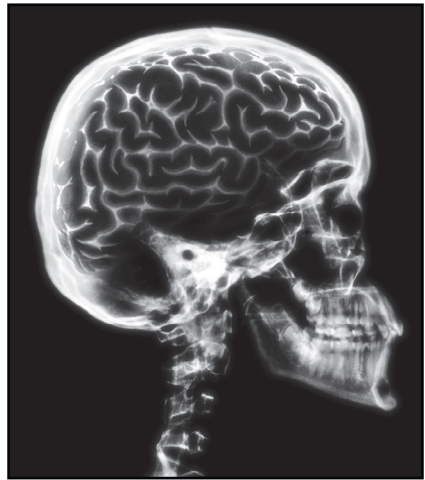
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**For the vast majority of human history, the uniqueness of our minds has been held to result from spirits.**

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In history there are 3 core views of the human mind. For the vast majority of human history, the uniqueness of our minds has been held to result from spirits—whether higher religious powers, animal spirits, souls, or other kinds of ineffable, inexplicable, and mysterious properties. Periodically, a different view

has emerged (and reemerged): naturalism, the belief that the world can be explained without resorting to supernatural phenomena and that the mind is the product of observable physical processes. A third perspective is humanism, where humans actively guide and shape their own behavior through giving meaning to their lives. Human qualities can't be reduced to supernatural forces or to strictly scientific, naturalistic, or biological perspectives.



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**The brain constitutes only 2% of the body's mass but uses about 20% of its blood supply and energy.**

Dualism entails the perspective that the mind is separate from the body and brain—in other words, that our ineffable thoughts, feelings, intuitions, and all other mental experiences cannot be “contained” within cells, chemical reactions, and/or bodies. Modern science and neuroscience, along with the demise of theocratic, religion-dominated governments, provide a huge challenge to dualism.

Yet precisely how our brains' incredibly complex chemical and electrical actions produce human mental powers, perceptions, and consciousness remains one of the key mysteries confronting us as a species. ■

### Suggested Reading

Bloom, *Descartes' Baby*.

Gazzaniga, *Human*.

Pinker, *How the Mind Works*.

## Questions to Consider

1. What are key similarities and differences among spiritual, naturalistic, and humanistic perspectives on the human mind?
2. What are the key ways in which our minds differ from those of other animals, even primates? That is, what are uniquely human characteristics of the mind?

# How the Human Brain Works

## Lecture 2

**Each cubic millimeter of cerebral cortex—the outer layer of the brain—contains roughly one billion synapses. This is right, I just said a billion. It's astounding: It is estimated that there may be over 100 trillion synapses in each of our brains.**

**T**he key building blocks of the brain are neurons, neurotransmitters, synapses, and glial cells. The individual cells of the brain are called neurons. They are composed of dendrites, cell bodies containing the nucleus, and axons. Although neurons conduct electric charges, there is a gap, called the synaptic cleft, between adjacent neurons. To cross the gap, a chemical, called a neurotransmitter, is released the presynaptic terminal.

Some neurotransmitters directly open ion channels to cause an action potential; others act more indirectly, influencing the dendrite's receptivity to other chemical input. Some neurotransmitters are excitatory, causing postsynaptic neurons to fire. Once the neurotransmitter has interacted with the receptor, it may remain in the synapse to work again, but most are removed from the synapse through a process called reuptake.

There are several influences on the efficiency and speed of neural firing. Some glial cells, called oligodendrocytes, form coatings around axons in the form of myelin sheaths, providing insulation. Axons with myelin conduct their electrical currents faster and more efficiently than axons without myelin.

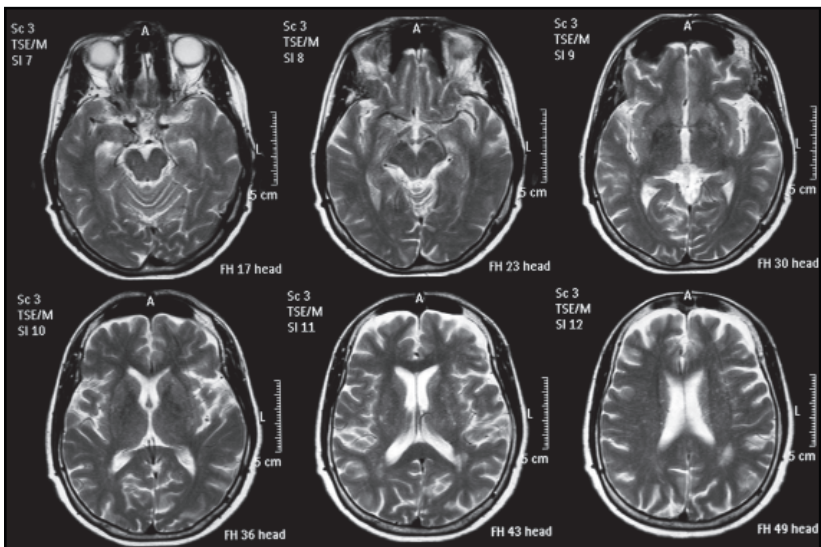
The brain can be subdivided in several ways. We can consider the basic divisions of hindbrain, midbrain, and forebrain. The outermost layer of the brain is the cortex, which originated with the advent of mammals. The cortex is divided into 4 regions, or lobes: frontal, parietal, occipital, and temporal.

Many subcortical areas are essential for our functioning. Core subcortical regions include the brain stem, amygdala, hippocampus, and cerebellum. Large tracts of neurons connect these various regions with the cortex. The association areas of the human cortex are especially large and critically important.

Psychopharmacology is the study and practice of medications that influence the brain and affect behavioral and emotional responding. Most psychoactive medications were discovered somewhat accidentally across the past 60 years. With the advent of modern brain science, including genetic technology, medications that act on certain specific neurotransmitters, or even specific receptors, can be crafted. Some psychoactive medications influence the production and release of neurotransmitters, some act on the mechanisms of transport/reuptake from the synapse back into the presynaptic terminal, and some influence the sensitivity of receptors.

**Psychopharmacology is the study and practice of medications that influence the brain and affect behavioral and emotional responding.**

Naturalistic perspectives on the brain and mind have existed, off and on, for several thousand years, but only recently have modern measurement tools allow us to view the working brain with real accuracy. Magnetic resonance imaging (MRI) comes in 2 forms,



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Structural MRI generates precise pictures of brain anatomy.



structural, revealing precise pictures of anatomy, and revealing blood flow and neural activity.

Unlike PET scans, which require that the individual have radioactive tracers ingested, fMRI is a safe, non-invasive way to see which portions of the brain “light up” soon after a certain task is performed. Other techniques, dating from the past several decades, allow scientists to see the locations of various neurotransmitters and neurotransmitter systems in the brain and the connectivity of neurons with one another. ■

### Suggested Reading

There are a number of textbooks on human neuroanatomy, neurology, and neurophysiology; they vary greatly in terms of their accessibility and difficulty level. A good primer on neuropsychopharmacology is Julien et al., *A Primer of Drug Action*.

### Questions to Consider

1. What are the advantages of a brain and mind with large tertiary association areas and wide connectivity with other brain regions?
2. What are some of the ways in which psychoactive medications can influence brain functioning and behavior?

# Development of the Human Brain

## Lecture 3

It was thought until the 1980s that infants were born with their entire complement of neurons; in other words, neurons could only be lost during the rest of the lifespan. It turns out that this is probably best considered an urban myth; in fact, mammals, primates, and humans appear to experience neurogenesis throughout their lives.

**B**abies are born with a plethora of neurons; infants have more than the 120 billion or so neurons they will carry throughout life. Basic calculations reveal that during every second of the 40 weeks of human gestation, several thousand new neurons are formed. Neurogenesis in the outer layer, or cortex, of the brain, is complex: New neurons are formed at the bottom and radiate toward the top, guided by glial cells called astrocytes.

Until recently, it was thought that neurons could only be lost during a person's life—but in fact humans do create new neurons, especially in the hippocampus. The size of the baby's skull, holding such a large brain, is just at the limit of what will fit through the mother's pelvis and birth canal during delivery. We appear to be “on the brink” of being able to be born with our large brain capacities intact.



**The human brain produces about 5000 new neurons during every second of prenatal existence.**

Neurons cannot communicate without the formation of synapses. A major task during the initial years of life is synaptogenesis, the formation of connections between the axons and dendrites of adjacent neurons. The major work of synaptogenesis occurs after birth; both genetic “programs” and life experiences that promote axonal sprouting and the formation of synapses. As

an example, it is rapid synaptogenesis that is correlated with the fast rise in language skills during the second and third years of life.

Neurons that do not form viable synapses wither and perish. Pruning is the process whereby non-viably-connected neurons are eliminated, making for a more efficient brain. Neural and synaptic plasticity refers to the additional changes in the brain that can result from experience. With repeated firing

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**Learning entails both the formation of new synaptic connections and the strengthening of existing connections.**

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of a set of neurons, synaptic connections become strengthened. Learning entails both the formation of new synaptic connections and the strengthening of existing connections. The essential principle is that experience matters greatly for the shaping, sculpting, and pruning of the brain.

Plasticity is quite remarkable at its extremes: When people lose certain regions of the brain through disease or injury, regions of the brain devoted to other functions can take on the lost function. As neurons develop and connections form, the infant's perception of the world becomes increasingly acute and integrated.

Perception is not a simple mapping of the world into an identical representation in the brain. Human perceivers "fill in" sequences of events with predictions as to where an object will be located, even if they have not actually seen the object move to that place. Are there limits to neural plasticity? Natural experiments, dealing with experiences of terribly deprived young children from orphanages, adopted into normal homes at different ages, have provided intriguing evidence.

A longstanding issue in animal and human psychology has been the concept of critical or sensitive periods in development. A critical period is a length of time during which certain experiences must occur, beyond which it's too late for a concept or skill to be learned or a behavior formed. A sensitive period is a length of time during which learning is optimized, although some learning may be able to occur beyond this time.

Natural experiments help us understand critical or sensitive periods for language, intelligence, and social behavior. True experiments with animals have revealed, for many decades, that “rich” environments promote active brain development far better than “impoverished” environments. We cannot randomly assign children to different environmental stimulations. Overall, humans have long periods of maturation, and some early social bonds and stimulation are necessary for optimal development. ■

### Suggested Reading

Gazzaniga, *Human*.

Nelson and Luciana, *Handbook of Developmental Cognitive Neuroscience*.

### Questions to Consider

1. In what ways does the electrical and chemical nature of neurotransmission facilitate communication in the brain? Why would nature have possibly “designed” such a dual system?
2. What are implications for social policies related to findings from natural experiments on the limits of plasticity for infants raised in orphanages?

# Evolution and the Brain

## Lecture 4

**Recent research has shown that adolescent chimps have better photographic memories than humans do. It seems that as we humans learn language, we may lose these eidetic or near-photographic memories many of us have as children.**

**D**arwin described natural selection and speciation in his 19<sup>th</sup>-century theoretical model. How can evolutionary theory explain the mind and behavior? Darwin believed that behavior as well as physical features of the phenotype could be explained on the basis of natural selection. His theory, updated with advances from modern genetics, is based on core assumptions:

- Traits are inherited across generations.
- Mutations create genetic diversity.
- Those organisms that have better reproductive success will be “selected” in terms of viable offspring who themselves reproduce successfully.
- Mutations related to brain function may create slight alterations in proteins, in turn shaping differences in behavior.

The adaptations most likely to have promoted human mental functioning are those that produced abilities such as processing of highly complex social information, inhibitory control, abstract reasoning, mental synthesis, the ability to project into the past and present, and the development of spoken language with flexible grammar.

Intriguing work by Dunbar suggests that human social groups are larger than those of chimps in part because of the evolution of language, which allows for maintaining social information without the exclusive one-on-one social

time. Evolution utilizes existing structures and functions, “tweaking” and co-opting them for new purposes.

What are the milestones, throughout evolutionary history, of the origins of the human brain and mind? Much work in brain evolution is speculative because brains and behaviors don’t leave fossils, the way that bones do.

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**Evolution utilizes existing structures and functions, “tweaking” and co-opting them for new purposes.**

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We can, however, infer brain size from fossilized skulls and we can examine the brain sizes of living species. There is a strong association between an animal’s body mass and its brain size.

More than 500 million years ago, the first neurons appeared in jellyfish, before brains came into being; early vertebrates had primitive brains, with neurogenesis, synaptogenesis, and myelination. About 180–200 million years ago mammals were the first to have cortexes. With the advent of primates, in the last 60–70 million years, frontal regions of the brain became relatively larger. Salient for humans are the number of cortical neurons, speed of conduction of neurons, massive connectivity, and size of tertiary or association regions of the brain that deal with abstraction and concepts.

What are the stages in the evolution of the minds of apes, through early humans, to modern humans? The model of Merlin Donald is intriguing:

- Great apes have highly developed episodic skills, the ability to remember; these are found in other mammals, too.
- *Homo erectus* and other protohumans are characterized by mimetic skills, involving imitation, gesturing, and other means of forging social bonds and cooperation.
- Modern humans, *Homo sapiens*, are marked by what Donald calls mythic skills: spoken and grammatical language—increasing the potential of cooperation and competition, the transmission of culture, and the intentional teaching of what’s learned.

Within the past few thousand years, humans have developed written language, fostering theoretical skills, modern science, and many facets of modern culture.

Many have contended that in human history, the recent explosion of art and culture across the past 30,000 or so years cannot be explained solely by Darwinian processes. One way of linking evolution and individual development is that the human

brain was naturally selected to be intensely plastic. Long periods of relative helplessness promote, in the end, far more malleable, flexible, and powerful behavior patterns. Our recent cultural inventions—written language, the printing press, computers—have apparently propelled our explosion of knowledge beyond the dictates of natural selection per se. ■



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**As primates came into being about 60–70 million years ago, brain sizes gradually increased.**

### Suggested Reading

Baumeister, *The Cultural Animal*.

Darwin, *On the Origin of Species*.

Dawkins, *River Out of Eden*.

Donald, *Origins of the Modern Mind*.

### Questions to Consider

1. In what ways can evolutionary principles explain the origins of the human mind?
2. How have spoken language and, most recently, written language fueled the mental powers and cultural advances of our species?

# Psychological Views of the Mind

## Lecture 5

Even though the predominant psychological therapies today are no longer Freudian, much of the way we think about the mind—in everyday language and even in New Yorker cartoons—is based on Freudian models.

Two key psychological views permeated 20<sup>th</sup>-century perspectives on the human mind. First, Freud and his followers posited that early emotional experiences interact with biological drives to create conflict, defense, and psychological symptoms. Second, beginning with Pavlov, Watson, and Skinner, social learning perspectives have emphasized the shaping of behavior through environmental contingencies, focusing on “laws” of learned behavior.

Freud’s psychoanalytic model and related psychodynamic models have been enormously influential, even though many of its principles have been extremely difficult to verify empirically and even though it has been criticized for outmoded views on female development and sexuality.

Psychodynamic theory is daunting in its complexity, but it is based on a few key principles.

- Beginning in infancy, each infant has underlying biological urges necessary for survival.
- With maturity, inevitable conflict ensues, given the need to suppress these pleasure-seeking urges in line with the good of the family and society.
- Conflict occurs between parent and child; anxiety develops in an attempt to resolve one’s selfish urge with the social will.
- The mind creates a number of defense mechanisms to manage these conflicts and anxieties.



- Many normal behavior patterns, and especially atypical ones, are symbolic—the surface symptoms “cover” the deep underlying conflicts, the meanings of which often remain hidden or distorted.

The goal of psychoanalytic therapies is to uncover the unconscious underpinnings of conflict, through often-intensive interpretive work.

Psychodynamic ideas have been highly influential in our culture, fueling notions of inevitable intergenerational conflict as well as inevitable conflict between the individual and society; unconscious underpinnings of human motivation; the importance of sexuality from the earliest ages; and the need for lengthy, interpretive therapy for healing. Although research on psychoanalytic concepts is mixed at best, this perspective guided much of 20<sup>th</sup>-century thinking about the human mind; it is central to current ideas about attachment and trauma.

As a counterpoint, social learning theories emphasize the mind as a blank slate, featuring the importance of learning to explain human behavior. In classic social learning models, the human infant has almost no instinctual patterns guiding its development and there is no need to posit deep unconscious conflicts. The first key learning mechanism is classical conditioning—the pairing of unconditioned stimuli with conditioned stimuli, which come to elicit a response. The second is operant conditioning. Watson, Skinner, and their successors documented that following responses with rewards or punishments leads to a greater or lesser likelihood of the behaviors’ exhibition in the future. In these classic social learning views, termed behaviorism, there was no need to invoke any conception of the mind, which was unobservable and therefore held to be impossible to study scientifically.

Despite the predominance of social learning and behaviorist models in psychology for much of the first half of the 20<sup>th</sup> century, early challenges to reinforcement theory and behaviorism began to occur as early as 1930. By the 1960s, it was discovered in new paradigms that some behaviors can appear without any reinforcement at all, through the organism’s having witnessed performance of behavior from a model.

Over time, behavioristic models have given way to cognitive-behavioral models, in which the organism's perception of and operations on the world are deemed essential. In fact, beginning in the middle of the 20<sup>th</sup> century, a cognitive revolution swept through psychology and the behavioral sciences. Behavior therapies include reward/punishment programs in special education and other clinical applications; cognitive-behavioral treatments for depression and anxiety disorders work to challenge the underlying belief patterns and teach the patient to discover new ways of combating negative emotions.

Several definitions of human consciousness are given. Self-awareness and sentience remain mysterious, though incredibly powerful, aspects of the human mind. Once dismissed as unscientific and subjective, speculation as to the nature of human self-awareness and self-consciousness is now one of the "hot" areas of modern cognitive science, psychology, philosophy, and neuroscience. It may take a kind of "theory of relativity"-style breakthrough to unravel this mystery. ■

**Over time, behavioristic models have given way to cognitive-behavioral models, in which the organism's perception of and operations on the world are deemed essential.**

### Suggested Reading

Dennett, *Consciousness Explained*.

Freud, *New Introductory Lectures on Psychoanalysis*.

### Questions to Consider

1. Why has Freudian theory been so influential throughout our culture, and why has it also been so difficult to validate?
2. In what ways are social learning theory, and its emphasis on learning, compatible with evolutionary views?

# Instinct, Learning, and Emotion

## Lecture 6

**Overall, the lack of a large number of instinctual or reflexive patterns is linked to the long periods of time that infants have to develop their malleable brains. We humans, this argument goes, need to develop flexible behavior patterns, not rigid, fixed responses preset at birth.**

**E**volution has shaped instincts for most animals. Instinctive behavior does not need a lengthy period of development; it is often extremely adaptive in unchanging environments. Yet reliance on instinct does not allow flexibility or malleability of individual behavioral responses, which may be crucial for species that need to make calculated decisions against predators or that may encounter changing ecological settings. It may take an environmental trigger to unleash certain instincts.

A predominant view is that humans have relatively few instincts at birth. One of the key instincts babies do show is active interest in the world during their waking hours: Infants are active participants in their own learning, rather than being passive recipients of stimulation. From another perspective, however, the mind is composed of many modules, instinctive and unconscious in nature. Even complex problem solving relies on the expression of such basic information processing programs and instincts.

Although Darwin was quite interested in emotion, documenting emotions throughout the animal kingdom and their similarities to those in humans, the study of emotions and emotional processes was relegated to a scientific back burner for many years. Recent decades have witnessed an emotion revolution comparable in scope to the cognitive revolution of the 1950s and beyond. Tomkins, Ekman, and colleagues revealed that emotion displays and emotion recognition are universal, overriding contentions that human cultures were the primary drivers of emotional processes. Emotion is

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**The study of emotions and emotional processes was relegated to a scientific back burner for many years.**

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now conceptualized not as an irrational, disorganizing signal but rather an organizing force—an adaptive predisposition to action related to key human goals and needs.

Emotions are essential for rational, productive behavior; brain lesions leading to a loss of emotional functioning produce an absence of goal-directed behavior. Some emotions are elicited instantly, without cognitive mediation; they are part of “lower,” evolutionarily early brain regions. Others, however, can be shaped—and most emotions can be regulated—through the use of more recently evolved brain structures and functions. In the origins and development of the human mind, emotions and cognitions are part of a large, organized network of naturally selected modules that appraise the environment, respond to key contextual features quickly and at times automatically, and allow for organized, planful responses.

Emotion regulation has been a key topic in the study of the human mind in recent years. Reappraising emotional triggers versus suppressing emotional displays is a core dichotomy in the study of emotion regulation. Emotion suppression may be effective in some instances, but there is typically a cost in terms of effort and physiological “spillover” for the person doing the suppressing. ■

### Suggested Reading

Donald, *A Mind So Rare*.

Ekman, *Emotions Revealed*.

Pinker, *The Language Instinct*.

Solomon, *The Passions*.

### Questions to Consider

1. What are the pros and cons for species that exhibit patterns of instinctive behavior versus those with far longer periods of learning to produce viable behavior?

2. In what ways do emotions “pull us down” to irrationality or “lift us up” to organized behavior and achievements?

# Microevolution, Culture, and the Brain

## Lecture 7

**Extremely exciting new science is taking place about the natural selection of the human brain and mind over relatively short periods of time, sometimes called “microevolution.”**

**E**volution proceeds through gene mutation, which can produce behavioral diversity. Such diversity can be adaptive in the context of changing environments, producing stronger chances of reproduction. Certain point mutations in genes related to the brain can produce slight variations in the sensitivity of post-synaptic receptors or in the functions of enzymes that facilitate neurotransmission. Such mutations may confer genetic and behavioral diversity, leading to reproductive advantage in changing environments; they would therefore be passed on to new generations.

What evolutionary forces shaped the origins of the modern human brain and mind? Because behavior and soft tissue like brains leave no fossils, we cannot be positive. Once human culture developed, natural selection may well have favored brains that could make use of culture and that could be receptive to considerable amounts of learning. Natural selection builds from pre-existing genes and structures, sometimes co-opting them for new purposes.

Studies of brain evolution now focus on microevolution rather than on the suppositions that human brains are radically larger or more developed frontally than those of our close relatives. Human brains develop more after birth than do those of other species. Human brains have larger tertiary association areas, parietal cortex, and thalamus regions than other species. Human brains are more asymmetrical—a greater proportion of humans are right-handed—revealing more specialization of function in our species. Human brains have greater proportions of spindle neurons, which send information very quickly in key brain regions.

Discovery of genes linked to brain development has spurred the field of evo-devo, evolution and development, providing a link between natural selection and individual development. Finally, we have experienced selection pressure

for plasticity—that is, for responsiveness to our environment, providing evidence for a Baldwin effect, a positive feedback loop between evolutionary and individual development.

The field of evolutionary psychology—formerly sociobiology—is quite relevant. What have humans accomplished in our time as a species? We have migrated into nearly every habitat on Earth and either coexisted with or dominated many of our competitor and prey species. There are core similarities across cultures in many cognitive processes and social behaviors

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strongly suggesting that humans must have inherited specific mental capacities for such tasks. During the long period of human prehistory, humans developed cognitive skills, as well as social and sexual behaviors, related to adaptive traits.

What is the role of cultural evolution in producing our major advances as a species? A key hypothesis, attributable to Richard Dawkins, is that of memes—units of cultural transmission, such as ideas,

behaviors, or values that are able to be imitated by others, which rise and fall according to natural selection-style processes. It is still an area of major contention as to how humans gained an unprecedented level of self-reflection and self-expression in relatively short timespans. Some contend that cultural evolution works separately from natural selection; others place modern human behavior in a Darwinian framework; still others links the 2. Overall, this course continues to operate at 2 levels: evolution, leading to species-wide changes; and that of individual development, leading to uniquely powerful and sometimes pathological outcomes in terms of the human mind. ■

### Suggested Reading

Buss, *Evolutionary Psychology*.

Gazzaniga, *Human*.

Wright, *The Moral Animal*.

## Questions to Consider

1. What is microevolution? How might it have shaped human brains and minds?
2. If evolutionary psychology is correct, and humans have evolved ingroup-outgroup biases and mating preferences via natural selection, are we destined to repeat certain core practices, such as prejudice and sexism, forever?



# Infancy—Temperament and Attachment

## Lecture 8

**The study of temperament has been quite important for helping us to realize that many important roots of behavior and the mind are apparent in early months, and that the “templates” of the mind may well have naturally selected and biological roots.**

**T**his course alternates between 2 themes related to the origins of the human mind: evolution and natural selection and individual development. A crucial tension in the course relates to the linkages across each of these conceptions. It was contended for over a century that individual’s earliest development mimics the evolutionary history across species. This view has some basis in truth but is largely discredited; some of its original advocates relied on anatomically inaccurate portrayals of fetal development. With respect to individual development, we can divide the human lifespan into the prenatal years and infancy; childhood; adolescence, and the adult years.

What is temperament, and how does it contribute to eventual personality, behavior, and mind? Temperament refers to patterns of attention, behavior, and emotion that are present during the initial months of life, that appear across different situations, and that tend to persist across time. They appear early enough in life that they are presumed to be biologically-based response tendencies, rather than the effects of caregiving. The persistence of temperament depends on which form of temperament is under consideration and on how the child’s environment responds. The concept of “goodness of fit” is quite important—that is, how the caregivers adapt to and accept the child’s temperamental style.

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**Attachment theory is a fascinating blend of evolutionary and psychoanalytic ideas.**

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What is attachment, and how does it contribute to eventual personality, behavior, and mind? Attachment theory is a fascinating blend of evolutionary and psychoanalytic ideas. Primates require proximity to caregivers for an extended timeframe.

Natural selection has produced a mutual response system, whereby infants show distress when separated and caregivers are responsive to distress behaviors. Yet individual differences exist in the quality of caregiving and the responses of infants to such parenting.

Although the infant's behavior upon the parent's leaving is noteworthy, it may be predicted by the infant's temperament. The infant's response to the parent's return—the reunion behavior—is predictable from the parent's sensitivity to the infant during the initial months of life. Categories of such individual differences in attachment behavior exist: securely attached, insecurely attached, and disorganized/disoriented.

On average, securely attached infants have better social relationships, emotion recognition, and emotion regulation throughout life than do insecurely attached infants. Disorganized infants are at risk for a number of serious problems, including aggression.

Overall, temperament and attachment reveal the importance of the earliest years for the development of the human mind, but neither is a complete determinant of later behavior. Many influences continue to operate across human development. ■

### Suggested Reading

Bowlby, *Attachment and Loss*.

Kagan and Snidman, *The Long Shadow of Temperament*.



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**An infant's cry is a universal sound almost certain to get an adult's attention.**

## Questions to Consider

1. What are key similarities and differences among spiritual, naturalistic, and humanistic perspectives on the human mind?
2. What are the key ways in which our minds differ from those of other animals, even primates? What are uniquely human characteristics of the mind?

# Childhood—Stages and Widening Contexts

## Lecture 9

**Development is a 2-way street. Children are not blank slates, passively responding to parental and environmental influence; they and their temperaments, as well as their potential for creativity and their general interpretation of the world, directly influence how parents respond to them.**

**I**n the development of the human mind and behavior patterns, characteristics of children are inextricably intertwined with characteristics of their surroundings. Throughout the history of developmental psychology, the usual model has been that older individuals exert a primary causal influence on younger individuals. It is now recognized that reciprocal determinism operates: not only does the adult environment influence the child, but the child's temperament and behavioral characteristics affect the adult caregivers.

Swiss philosopher and biologist Jean Piaget posited 4 stages of the child's cognitive development; each stage emerges from maturation and interaction with the environment. The infant and toddler stage is called sensorimotor: the youngest child learns of the world through active sensations and motor movements. Next, from ages 2-6, the child enters the preoperational stage: Language provides for symbolic communication, but regular errors in reasoning about objects in the world is present. At roughly age 7, the concrete operational stage emerges: children begin to realize, for example, that both the length and width of a container are relevant to the amount it can hold. By the very beginning of adolescence, truly abstract reasoning emerge.

The earliest environment is created by the family. Beyond the parent's sensitivity to the child, promoting the attachment bonds that form in infancy, the family setting is crucial for years to come. Across cultures and across history, 2 fundamental dimensions of parenting behavior have been found: the family's warmth and responsiveness to the child and its control of and demands placed on the child. Many studies reveal that these 2 dimensions are essentially uncorrelated. As a result, we can form 4 core "quadrants"

or styles of parenting practices. Authoritative parenting is marked by high warmth/responsiveness and high control/demands. Authoritarian parenting is marked by high control/demands but relatively low warmth/responsiveness. Permissive parenting is marked by low control/demands but high warmth/responsiveness. Neglectful parenting is marked by low levels of each dimension.

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**The influence of  
peer groups on the  
development of the  
mind is unmistakable.**

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The influence of peer groups on the development of the mind is unmistakable. As children mature, peers exert greater influence than parents—although early parenting sets the stage for the kinds of peers the child selects. Children who are rejected by their peers are at risk for delinquency, depression, school drop-out, and later mental health problems, over and above the levels of problem behavior that may have engendered peer rejection in the first place. Deviant peer association is linked with substance abuse, early sexual problems, and spiraling patterns of maladjustment.

Neighborhoods are a key influence on development. Violent neighborhood settings may engender post-traumatic responses, provide models of violence, and yield a pervasive sense of insecurity. Interactive effects are salient: Research shows that impulsivity in children is especially likely to produce violence and aggression when the impulsive child is exposed to violent, dangerous neighborhoods.

The culture at large produces fundamental and profound effects on the human mind; and our minds may have evolved to make use of culture. Much of human psychology and much of evolutionary theory emphasize the fundamental similarities across individuals. At an evolutionary level, it may well be that our brains and minds became as complex and interconnected as they did largely because of the huge demands placed by our intensely social natures. Although there are limits to cultural relativism—for example, language does not shape our thinking as much as was believed within the last century—culture can shape individual differences in our very perceptions. ■

## Suggested Reading

Baumeister, *The Cultural Animal*.

Siegler, Deloache, and Eisenberg, *How Children Develop*.

Wilson, *Consilience*.

## Questions to Consider

1. Which is the greater influence on the development of children's minds and behavioral styles: parents and families or peers and neighborhoods?
2. Is human nature strongly universal—that is, do people share similar processes and functions across all cultures? Or, can cultural “lenses” shape fundamental perceptual and emotional processes?

# Adolescence—Rebellion, Identity, and Self

## Lecture 10

Adolescence poses a real puzzle. It is the phase of life with the most physical strength and resilience, but it is also a time period with real risk for injuries, risk taking, and the development of serious mental disturbance.

Adolescence is a concept that has been recognized only in the past century. It refers roughly to the period of time from physical maturation to the end of the teenage years or to the period of independence from families of origin. Puberty is starting earlier; the average age of menarche for girls was above 14 years of age a century ago and is just over 12 today. Boys' ages have also dropped by a similar amount, but still roughly a year later than girls'. Even though pubertal timing is influenced by one's genes, it is clear that changes in nutrition and diet over the last century have lowered the age of puberty. The hormone surges associated



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**Modern adolescence is beginning earlier and ending later.**

with puberty affect not only physical and sexual characteristics but also brain development and emotional control. In other words, hormones linked to adolescence further shape the mind.

In many Western nations, adolescence is extending for ever-longer periods of time, well beyond the initial hormone surges and subsequent maturation, given post-secondary education for growing numbers as well as periods of “drift” between the end of high school and full employment/independence.

The predominant stereotype is that adolescence is a time of intense stress and rebellion. Adolescence is a time of unparalleled physical strength; physical speed, reaction time, immune function, and reasoning all increase, often dramatically. On the other hand, there is a rise in antisocial behavior in both sexes. Adolescence is a time of experimentation, or worse, with alcohol, tobacco, or illicit substances. Overall, physical and mental disorders double during this developmental period. Adolescence is also the period of time during which identity consolidates.

Both formal operations and executive functions mature significantly during adolescence. Formal operational thinking is the final stage of cognitive development, as defined by Piaget, during which young adolescents show “reversibility” in their thinking and the ability for abstract thought. It is also a time of continued maturation of the frontal lobes of the brain. The frontal regions of the brain do not fully mature, as once thought, by early adolescence or even by late adolescence but not until during the 20s. Thus, even at a biological and neurological level, adolescents are prone to show risk taking, emotional dysregulation, and impulse control issues. Sleep is a key issue for adolescents; research shows that, even when placed in sleep labs without day or night signals, adolescents show delayed sleep onset at night and a proneness to sleep in later in the “morning.”

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**Sleep is a key issue  
for adolescents.**

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What are normative self-perceptions during adolescence and adulthood? How does the mind view itself? Young children have greatly inflated self-images. By late childhood and early adolescence, as viable comparisons are made with a growing peer group, self-image is tempered, becoming more realistic.



Depression is associated with very low self-image. Yet some research reveals that individuals with moderate depression may actually be “realistic”—they perceive themselves as negatively as others perceive them. In parallel, those individuals with “normal” adjustment typically show a pattern known as self-illusory bias, meaning that they evaluate themselves more positively than others evaluate their performance.

Having self-perceptions that are too greatly inflated—a pattern termed narcissism—is associated with a host of problems, psychologically and interpersonally. Overall, a wider sense of purpose and exposure to alternative worldviews may help divert attention from an overly narrow focus on the self.

In the way that social context and culture may have been the driving forces behind the origins of our modern minds, at the level of natural selection, close attention to others’ well-being and a sense of social purpose may be essential aspects of the developing mind of each individual. ■

### Suggested Reading

Anderson and Jacobs, *Executive Functions and the Frontal Lobes*.

Goldberg, *The Executive Brain*.

Steinberg, *Adolescence*.

### Questions to Consider

1. What are key similarities and differences among spiritual, naturalistic, and humanistic perspectives on the human mind?
2. What are the key ways in which our minds differ from those of other animals, even primates? That is, what are uniquely human characteristics of the mind?

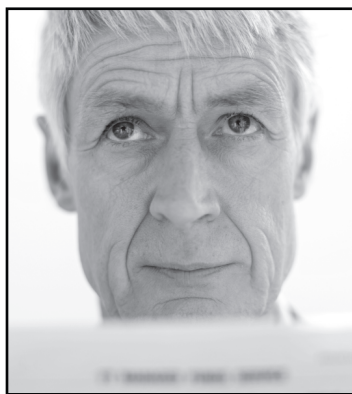
# Adulthood—Aging, Horizons, and Wisdom

## Lecture 11

**As we age, despite declines in physical and cognitive functioning, many of us may become masters of emotion regulation and emotional intelligence.**

**I**n early adulthood, many aspects of human perception, cognition, and motor skill reach high levels. Perception involves gaining appreciation of the world through our sense organs. It is an active process, rather than a passive recording of the external world. Cognition involves an intricate interplay of innate structures and templates as well as mental processes for interpreting knowledge of the stimuli we perceive and the experiences we have. Self-perception, to be adaptive, may require a modicum of positive illusory bias, such that we perceive ourselves through lenses with a rose hue. Emotions are not disorganizing, irrational responses to stimuli but rather constitute organizing forces in our lives, concentrating our focus on needed action. Executive functions are a hallmark of human functional capacities.

The key issue for this lecture has to do with aging. How old is “old” in the current era? The lifespan in most nations continues to rise, and the limits of our longevity are being pushed ever further. It is claimed that “70 is the new 50,” as unprecedented numbers are now living until 80, 90, or 100 years of age. Still, in many parts of the world, and even in poorer parts of the United States, the effects of poverty, limited access to health care, infant mortality, and rampant infectious disease make long life a rare luxury.



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**Many humans' emotional intelligence improves as they age.**

What are the effects of aging on the human mind? Most traditional tests of motor speed, language abilities, and other aspects of the broad range of human

function reveal that the peak ages are relatively early in life, with gradual declines ever afterward. For speeded spatial and motor tasks, performance begins to wane after the teen years. For most verbal fluency tasks, the peak is somewhat later, with maintenance of high abilities for many decades, with use and practice. Most of the key personality traits are reasonably stable. Still, change does occur; extraversion decreases whereas conscientiousness often increases as we age. Evidence exists that physical and mental activity may build a kind of mental reserve, quite useful if aging or illness erodes

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**Evidence exists  
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mental functions.**

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mental functions—although some claims about the huge restorative effects of either type of activity are undoubtedly overstated.

Recent evidence reveals what has been suspected for some time—and what some societies have long held: Namely, wisdom may accompany aging. Socioemotional selectivity theory (SST) has become an important insight in this regard. The evidence is based on research dealing with the human mind's ability to regulate emotions. As individuals progress from middle age to old age, a key developmental task is to maintain integrity,

while facing the inevitability of major losses and increasing awareness of the nearness of their own demise. There is some evidence that aging individuals actually do lower degrees of emotional intensity, perhaps reflecting a direct lessening of emotional reactivity. At the same time, many aging individuals develop their ability to regulate displays of emotion and to “save” intense emotions for situations that truly require it.

SST contends that as people age, their perceptions of time remaining become predominant. With this foreshortened future, people are motivated to enhance personal meaning and value from preserving the experiences and relationships they have. This theory helps us to resolve a key paradox: As people age, they have smaller social networks, less interest in novelty, and reduced spheres of influence—but at the same time, they are generally as happy as if not happier than younger adults. Possible downsides with this strategy include the potential for older adults to become duped by unscrupulous economic schemes or to underestimate risk. Overall, however, aging is accompanied by a maximization of personal meaning and positive emotion. ■

## Suggested Reading

There are no book-length accounts of socioemotional selectivity theory as of yet. An excellent summary of research on aging is found in Schaie and Willis, *Adult Development and Aging*.

## Questions to Consider

1. In what age ranges do human performance peak—and to what extent does the answer depend on different abilities? What do the answers here signify in terms of evolution?
2. The media often portray older adults as senile, incompetent, or even foolish. How does current evidence regarding the development of wisdom contrast with such images?

# Influences of Sex and Gender

## Lecture 12

Before sex, and before sexual combinations of genes with male alleles in sperm fertilizing female alleles in eggs, there was essentially no death. Organisms, and their clones, simply continued across time. Once sex was “invented” by evolution, with male and female forms of organisms appearing and with combinations of their genetic heritage occurring, then true death of the parent organism became, for the first time, possible.

**A**t an evolutionary level, sexual reproduction yields combinations of genes, promoting diversity. It is commonly assumed that sex refers to biological characteristics, determined by genes, whereas gender involves masculine versus feminine roles, shaped by culture. Yet sex, gender identity, and gender roles are products of biology and culture. This lecture covers the fascinating issues surrounding our differentiation of boys and girls, men and women.

Many have promoted the notions that either no real differences exist, at a biological level, between men and women or the 2 sexes are fundamentally from different planets! Both of these positions are simplistic and reductionistic. Although the terms can be used synonymously, sex typically refers to a person's male versus female biological characteristics, whereas gender involves the roles and personal identity as masculine versus feminine, with both biological and cultural determinants. In reality, however, biological sex



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**Gender is more of a cultural construction than a biological reality.**

is not completely determined by chromosomes, as evidenced by individuals with indeterminate chromosomes or with hormonal conditions early in life.

Both biological and environmental factors are influential in shaping sex and gender roles. In terms of evolution, sexual reproduction led to diversity, with combinations of male and female alleles; before sexual reproduction, organisms and their clones just perpetuated. Psychologically, we can describe traditionally masculine or female traits. Androgyny represents a combination of both.

All humans begin life in the womb as females. For those with an XY configuration, events in the womb promote masculinization. For males, a specific gene on the Y chromosome, known as SRY, promotes the secretion of male sex hormones. These hormones shape male sex characteristics, with the beginning signs of male sex organs appearing between weeks 8 and 12 of prenatal existence. Androgens, especially testosterone, surge in males again at puberty, with deepening of the voice and a number of other sex characteristics. In females, puberty marks a surge of estrogen and other hormones, promoting female maturation.

How different are infant boys and girls? The cultural stereotype is that boys are more active and impulsive while girls are more reflective and thoughtful. When direct observations are used, most dimensions of infant temperament do not show large sex differences. On the other hand, some differences can be seen as early as 1 week or several months of age: Girls are more reactive to distress, more responsive to people, and make greater eye contact.

One of the largest sex differences, in humans as well as primates, is in choice of play items: Despite socialization efforts, males prefer objects and girls prefer dolls. Clearer sex differences in temperamental characteristics emerge during the second year of life, suggesting a role for the combination of unfolding biology plus family and cultural expectations.

Key differences in behavior, emotion, and cognition emerge in the preschool years. Girls show earlier language development, talking in longer, more complex sentences than boys, from young ages. Girls are more likely to follow adult rules and show greater distress if they have displeased parents

or teachers. Girls are more likely to show cognitive empathy (understanding the distress of others) and emotional empathy (feeling the pain or pleasure of others) than boys.

In terms of social relationships, girls are more likely to play in small, intimate groups, with much verbalization; boys cover wider territory, with more fleeting interactions. As a result, girls are protected against “externalizing” problems during childhood, such as aggression and hyperactivity. They are also less likely than boys to show autism.

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**In terms of social relationships, girls are more likely to play in small, intimate groups, with much verbalization.**

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Intriguingly, a surge of romantic attraction tends to occur at ages 8–9, several years before puberty; this is mediated by an increase in adrenal hormones at that time. At puberty and adolescence, sex differences become accentuated. The age of menarche

has dropped across the last century. With the advent of puberty in boys and in girls, sex hormones surge, leading to physical and psychological differentiation. The risk for what are termed “internalizing” problems, such as depression, anxiety, eating disorders, and self-mutilation, rises for girls in the early years of adolescence. The very qualities that appear to protect girls from externalizing problems during childhood may serve to promote risk for internalizing problems during adolescence.

How strong are sex differences in cognitive performance, and in the brain? Overall, there are small sex differences in cognitive abilities as children age: Girls maintain an advantage in verbal skills and abilities, and boys have an advantage in spatial skills like mental rotation, which could aid performance in geometry. Overall intelligence, however, is almost identical between the sexes. Boys and men also show greater risk-taking than girls. Males are more variable than girls across many traits, with more males at both the high and low ends of performance.

What about the contentious topic of achievement? In math, boys and girls are fairly equal in elementary school, but traditionally, girls fall behind by middle school and high school. In other cultures, such as China and Japan,

both boys and girls perform better, on average, than those in the United States, because of cultural expectations and pressures. Recent U.S. data are quite revealing: The gap between the sexes in mathematics has closed over the last 20 years. The reason is that girls are now tending to take as many advanced math classes as boys.

Male and female brains do show some differences in structure and function, as would be expectable given our evolutionary history. But whether these differences are meaningful contributors to behavior is unclear. Evolution and biology may well lead to real but relatively small sex differences in brains and minds and in behavioral tendencies; but with opportunity, plasticity in both sexes is clearly the dominant pattern. ■

### Suggested Reading

Brizendine, *The Female Brain*.

Hines, *Brain Gender*.

### Questions to Consider

1. Why would young girls, on average, show more empathy, compliance, and verbal skills than boys; is this a biological phenomenon or related more to early upbringing?
2. Are there social or educational policies that might continue to reduce the “gender gap” in science and math?



# Parallels between Development and Evolution

## Lecture 13

**How does this reciprocal determinism work? In the case of individual development, one variable (let's say a gene) has an effect on a downstream process—it codes for a protein, maybe helping to sculpt a brain, which creates behavior—but that behavior, in turn, influences the genetic tendency in the future in a kind of relentless spiral.**

**E**nvironmental and biological factors operate reciprocally and transactionally in both individual development and evolution by natural selection. It is not just that influences work together; they do so by repeated patterns of reciprocal influence. When such reciprocal influences repeat themselves over time, we say that the process is transactional. Transactional processes also characterize evolution. A mutation may induce a behavior change that is adaptive in a certain environment; the environment then produces selection pressure favoring reproduction for those individuals with the mutation and its new behavior patterns. Co-evolution occurs when changes in one species influence changes in another.

Does development occur smoothly and continuously, or discontinuously and in stages? In some ways, this is a trick question: whether a graph of individual development or evolutionary development looks smooth or not depends on the time scale one uses. Self-organization, and nonlinear progressions and patterns are quite important in conceptualizing the development of the human mind. Similar patterns may characterize evolution. Both the mind and behavior patterns emerge during stages in ways that are self-organizing—they develop from the system's own internal feedback systems.

**Does development occur smoothly and continuously, or discontinuously and in stages?**

Many key motor, cognitive, and behavioral systems show sudden, nonlinear progressions. After a period of relative stasis, small individual fluctuations can rather quickly stabilize into new forms and patterns. At a much larger scale, evolution and the development

of new species do not occur gradually and linearly but rather through punctuated equilibrium.

Risk and protective factors constitute an important area of studies of the human mind. A risk factor exists prior to the negative outcome of interest and statistically predicts the outcome's occurrence. Several types of risk factors exist: Fixed risk factors cannot be easily altered: Male versus female status, or temperamental ease versus difficulty. Malleable risk factors are modifiable: parenting styles or schools. Spurious risk factors appear to predict negative outcomes, but do so only because they are themselves correlated with other, more essential factors.

The premium is discovering causal risk factors. Yet it is quite difficult to understand their nature, as it is practically, and ethically, impossible to do an experiment and randomly assign some youth to conditions of abuse and others to non-abusive environments. To predict outcomes optimally, we must examine multiple risk factors. The presence of any 1 risk factor does not greatly increase the likelihood of negative outcomes, but 2 risk factors produce a much higher likelihood—and so on.

Not everyone exposed to 1 or more risk factor inevitably shows poor outcome. So, the question becomes how to understand those who defy the odds. Resilience is the set of processes that can yield better-than-expected outcome, in the presence of risk factors. The search is underway to define protective factors, those qualities or experiences that, under conditions of high risk, produce competence and strength. ■

### Suggested Reading

Beauchaine and Hinshaw, *Child Psychopathology*.

Werner, *Overcoming the Odds*.

## Questions to Consider

1. Discuss some of the parallels between individual development and evolution, with respect to biology and context, continuities and discontinuities, and the like.
2. What are the contextual factors, including risk and protective factors, that shaped your own and your family's development?
3. Should policies designed to reduce suffering from trauma, poverty, and/or mental illness focus more on reducing risk factors or promoting protective factors?

# Myths and Realities of Heritability

## Lecture 14

**Given the plasticity of our minds, ... how is it that genes and environments work together in shaping our emotions, behaviors, and minds overall? Genes are not a complete blueprint; but our minds are not blank slates, either.**

Following a period of relative neglect throughout much of the 20<sup>th</sup> century, when environmental influences on behavior and the human mind were dominant, there has been a major resurgence of interest in genes and their influence on behavior across the past several decades. The decoding of the human genome at the beginning of the 21<sup>st</sup> century set the stage for a new area of work on genetic influences. In this lecture and the next, we will see that it is a combination of genes and environments that always make the key difference. And, epigenetic forces—factors that influence gene expression but are not a direct part of genetic material—are essential to consider.

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**It is a combination of genes and environments that always make the key difference.**

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The concept of heritability is quite important for establishing the effects of genes on behavior and the mind—yet it can be quite misunderstood. Many believe that a particular behavior, trait, or emotion, is the product of genes versus environments. But any common trait is actually the full product of both genes and environments; we can't separate out the influences. It does make sense, however, to talk about differences across people—and the extent to which such difference are attributable more to genetic influences or environmental influences.

Heritability is a statistic that gives the percentage, from 0 to 100, as to whether difference between people are attributable to genes; all environmental influences are considered 0% heritable, where as 100% signifies all genetic. How do we infer heritability? The typical methods are family or pedigree studies, comparing risk across various relatives; and twin studies, comparing identical twins to fraternal twins. Both are confounded, in part, by similar



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**Studies of identical twins raised apart have shown strong evidence for heritability.**

environments in close relatives. If there is greater concordance in identical twin pairs than fraternal twin pairs, heritability can be assumed. Identical twins reared apart from infancy provide an even better test. Adoption studies are also used, with the aim of determining whether biological versus adoptive relatives are more similar in a given trait, behavior, or condition.

A number of misconceptions are found in relation to the concept of heritability. Many believe that a high heritability reflects the effects of a single gene on the behavior or trait in question. Heritability refers to the relative influence of genes, rather than environments, on individual differences in a trait or behavior in a given population at a given point in time. It does not pertain to the percentage of any individual's liability for the trait or behavior. Most people believe that heritability implies stability of the trait in question across generations. But, in fact, the overall levels of a highly heritable trait or behavior, over time, may be dependent on environments, not genes.

Many contend that genes tell us everything about behaviors and traits with moderate to high heritability. It is mistaken to think that heritable traits and conditions are completely refractory to environmental input, in order to alter

the course of the condition for individuals. The overall point is that there is great malleability in human behavior, even though genes may set a number of preconditions. ■

### Suggested Reading

Plomin, DeFries, McClearn, and McGuffin, *Behavioral Genetics*.

Rutter, *Genes and Behavior*.

### Questions to Consider

1. Why is a trait or condition that is moderately or strongly heritable still able to be influenced by the environment in terms of its long-term outcomes?
2. What are some of the key factors that may be related to the recent decreases in aggression and antisocial behavior among boys, as well as the recent increases in such behavior patterns in girls?

# Genes and Environments Together

## Lecture 15

**What's the important message about gene-environment correlation? Very specifically, separating genes and environments in the classic additive model isn't accurate. ... The effects of genes are enhanced because of environments that accentuate the genetic potential.**

In the classic additive model of behavioral genetics, there are 3 core influences on behavior and the mind. Genes: Heritability refers to the effects of genes on individual differences in a behavior or trait. Shared environment: These influences are those contextual variables that siblings experience together—such as poverty or parental discipline styles that are similar across children. Non-shared environment: Here, contextual variables differ among siblings. These include parenting practices that diverge across children or the different peer groups experienced by the different children in a family. The assumption is that all 3 of these influences sum to 100% in terms of their influence on behavioral variability and that they are independent of one another.

For most traits that constitute the normal range of human functioning, genes explain a moderate amount of variance, shared environments explain a small portion, but non-shared environments explain an amount comparable to that from genes. This pattern is surprising, as it contradicts the predominant belief that a family's general child-rearing style is extremely influential. The implication is that a range of idiosyncratic, highly individualized experiences determine much more of the human mind than previously believed. An exception to this pattern is the outcome of aggression or antisocial behavior, for which shared environmental factors play a significant role.

**Genes and environments tend to go together, and certain environments may accentuate the effects of certain genes.**

Considerable research challenges the assumption that these 3 components are actually independent. Genes and environments tend to go together, and



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**The effects of genes are enhanced by environments that accentuate the genetic potential.**

certain environments may accentuate the effects of certain genes. The first important concept is gene-environment correlation—signifying that the genes passed along from parents to children are often associated with the environments in which the children find themselves or create for themselves. The heritability of many behavioral traits increases with age; the implication is that genotypes are accentuated by environments across development. In passive gene-environment correlation, genes that are common to both parents and children influence parenting behaviors.

In active gene-environment correlation, the child inherits tendencies from the parents that propel him or her to perform behaviors that accentuate the inherited traits: The child's heritable tendencies influence the selection of environments. In evocative gene-environment correlation, the child's inherited tendencies elicit responses that accentuate existing vulnerabilities.

The second important concept is gene-environment interaction. Here, the idea is that environments may well determine whether a gene actually exerts an effect on the mind or on behavior. Several important examples have been



discovered by Caspi and colleagues. The first is related to risk for serious depression: A combination the inefficient form of the serotonin transporter gene, plus high levels of negative life events strongly predicted depression by age 26. Unless the 2 factors, genes and environments, have been considered together, it could easily be assumed that the gene had no effect on depression or that life events mattered little.

The essential point is that the common dichotomy of nature versus nurture is outdated and inaccurate. Nature and nurture combine in incredible ways to shape the human mind. Overall, genes and environments are not as separate as one might believe. ■

### Suggested Reading

There is a host of research on how genes and environments combine in novel ways to shape both positive/adaptive and negative/problematic behavior patterns. The results of such work are found in scientific journals such as *Science*, *Development and Psychopathology*, *Archives of General Psychiatry*, and others. Key contributions have been made by Caspi and Moffitt. For the best compilation of theory and research in this area, see Rutter, *Genes and Behavior: Nature-Nurture Interplay Explained*.

### Questions to Consider

1. What is meant by the concept of gene-environment correlation and how does it reveal unique ways that genes and environments work together?
2. What is meant by the concept of gene-environment interaction, and how does it reveal unique ways that genes and environments work together?

# The Abnormal Mind—What Goes Wrong?

## Lecture 16

During the 1990s, the World Health Organization (WHO) decided to take a numerical look at the impact of all illnesses across the world. ... They composed a formula involving what are called “Disability Adjusted Life Years” (DALYs) to serve as an objective indicator of the actual impact of illness on productivity. ... The findings, back in 1996, were startling. Among the 10 most impairing illnesses on Earth, 4 were mental disorders: schizophrenia, depression, bipolar disorder, and obsessive-compulsive disorder.

A strikingly high percentage of individuals develop 1 or more forms of mental disorder throughout their lifetimes. Far from being figments of the imagination or products of weak volition or will, mental illnesses are among the most impairing conditions on earth. Studying the ways in which the mind can “go wrong” tells us a great deal about the ways in which the mind can flourish, and vice versa.

A major question is whether mental disorders exist on a continuum with normal behavior or constitute separable, discontinuous categories. Evidence is accumulating that nearly all forms of mental disturbance exist on a spectrum—that is, they lie on a continuum with normal behavior. The prevalence of mental illness is high, yielding strong impairment. Across the world, the major forms of mental illness have remarkably similar prevalence rates, strongly suggesting biological and evolutionary rather than purely cultural roots. Severe mental illness, involving psychosis, serious substance abuse, or suicide attempts, affect 6% of the population. Moderate forms, which can also be debilitating affect an additional 20%.

Levels of impairment are high: Risk for suicide, loss of economic productivity, devastation to close relationships, impaired parenting skills, deep shame, and high risk for being victimized are all involved. The Global Burden of Disease studies reveal that several forms of mental illness—including schizophrenia, depression, bipolar disorder, obsessive-compulsive

disorder, and substance abuse—are in the top 10 most disabling diseases on the planet, rivaling infectious diseases, cancer, heart disease, and HIV.

An essential issue is how we can define behavioral abnormality or mental illness. Several different models have been proposed over the years.

- **Statistical:** Mental illnesses are behavior patterns that fall on the “tails” of the normal distribution or bell curve. Yet knowing where the cutoff lies for differentiating normal versus abnormal scores is usually arbitrary.
- **Social deviance:** Behavior patterns that violate a given society’s social norms are indicative of mental illness. Yet when we define mental illness on the basis of social deviance, there is a great risk of branding unpopular or politically controversial behavior as the product of an underlying disease process.
- **Moral:** Here, it is not simply social deviance but moral violations that are branded as products of mental illness. Although this attribution is clearly made when religion dominates the ruling of a society, moral ascriptions still occur in modern, secular cultures.
- **Medical:** Mental illnesses reflect disease processes operating at the level of the brain or mind.
- **Ecological/impairment:** Mentally ill behavior does not result from either inner dysfunction or faulty environments but from a mismatch between person and context.
- **Harmful dysfunction:** Proposed by Wakefield, it has an explicitly evolutionary perspective. For consideration as mental disorder, a behavior pattern must create harm and reflect an underlying dysfunction in a naturally-selected mental function.
- **Transactional:** Borrowing heavily from developmental psychopathology, this model integrates the study of normal and atypical development. People with mental illnesses are not

qualitatively different but lie farther out the bell curve of various dimensions of functioning and symptoms.

Trauma also has major implications for mental dysfunction. Trauma involves extreme environmental distress that can be life-threatening, literally or symbolically. In our conflict-laden world, trauma can involve war and torture, abuse, rape, environmental disasters, or exposure to violence. The human mind is configured to respond to trauma through several self-protective mechanisms, which may, unfortunately, compromise later functioning when the traumatic stressor is removed. Post-traumatic stress disorder (PTSD) is a major category of mental illness. It comprises 3 main areas of impairment, including hypervigilance and strong indicators of anxiety, numbness and avoidance, and re-experiencing of the event. Not all individuals exposed to life-threatening trauma develop PTSD, which is moderately heritable: genetic vulnerability exists for extreme reactions to trauma. ■

**Post-traumatic stress disorder (PTSD) is a major category of mental illness.**

### Suggested Reading

A host of excellent textbooks on abnormal psychology exist: For example, Kring and Johnson, *Abnormal Psychology*. For a review of models of psychopathology, see Hinshaw, *The Mark of Shame: Stigma of Mental Illness and An Agenda for Change*, chap. 1.

### Questions to Consider

1. What are some reasons why mental illnesses have come to supplant many physical illnesses as the most impairing conditions a person might encounter during his or her lifetime?
2. Which of the definitions of mental illness offered in this lecture is most compelling to you, and why?

# Rationality, Psychosis, and Schizophrenia

## Lecture 17

**What does “schizophrenia” literally mean? From the Greek, it means “split mind.” This really means “a splitting of thought and affect” from the people who originated the concept, but it’s not the same as a split or multiple personality, which we now call “dissociative identity disorder.”**

**T**he capacity for rational thought is believed to be a uniquely human ability. Humans’ ability to perceive the outside world with accuracy enabled our survival amidst larger and faster competitors. Clearly, there was selection pressure on such traits. On the other hand, humans are imbued with a number of mental heuristics that do not always consider rational contingencies or long-term consequences.

Psychologists have distinguished 2 types of thinking: the first of which is highly intuitive, reflexive, and automatic, yet prone to errors; the second is controlled, effortful, and judicious, yet costly in terms of mental energy. When one has lost the capacity for the second type of reasoning and thinking, unable to perform careful analysis of long-range consequences, functioning is likely to be severely compromised. At times, a lack of clear perception or rational thought, including primary process thinking propels artistic and spiritual experience. Overall, when distorted perceptions and irrational thought processes cannot be controlled, devastation may result.

Psychosis is a syndrome, a constellation of associated behaviors, involving major problems in perception, rational thought, and behavior control. A core feature is hallucinations, which involves perceptions of sights, sounds, aromas, and sensations of touch in the absence of external stimuli. Auditory hallucinations are the most common. Delusions are prominent; these are fixed, false beliefs that are impervious to counterargument. These can be grandiose, self-deprecating, or sometimes quite bizarre. Paranoid delusions increase the potential for the individual’s aggression.

Formal thought disorder, a breakdown of the logic of thought, is marked by associations that are loose, meandering speech, and a breakdown of reason. Agitation and loss of contact with reality are also part of psychosis in many cases. A syndrome may have multiple origins. Psychosis is associated with severe mania or depression, advanced stages of HIV infection, extremely high fever, sensory deprivation, and to the disorder termed schizophrenia.

Schizophrenia is a condition documented throughout history and in every culture, which involves periods of psychosis, along with or alternating with deficit symptoms—low motivation, loss of pleasure, social isolation, restricted or unusual affect. Approximately 1% of the world's population has schizophrenia, with nearly equal rates in each nation. In some cases, symptoms wax and wane; in other cases, the clinical presentation is chronic. The impact of schizophrenia on individuals and families is devastating, with nearly all areas of life functioning negatively affected.

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**Formal thought disorder, a breakdown of the logic of thought, is marked by associations that are loose, meandering speech, and a breakdown of reason.**

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Although families were blamed, for much of the 20<sup>th</sup> century, for causing schizophrenia via negative or intrusive parenting, the heritability of schizophrenia is substantial (50–60%). Recent evidence reveals that deletions of genetic material from chromosomes may be involved in some cases. Prenatal and perinatal complications may also play a role. A number of brain systems and regions are implicated in schizophrenia: Dopamine-containing neurons projecting from the midbrain to the frontal cortex are implicated in psychotic symptoms; the so-called deficit symptoms appear to involve multiple brain regions, including frontal lobe regions.

There are a range of developmental manifestations and impairments related to schizophrenia. Schizophrenias typical age of onset is in the mid- to late teen years or very early adulthood. It is unknown if hormonal surges of adolescence, the identity issues confronting adolescents, drug use, or some combination of these and other factors trigger the onset.

Studies reveal that schizophrenia can be predicted from observations made during infancy and toddlerhood. Children who later develop schizophrenia, contrasted with a control group, reveal abnormalities of motor behavior and unusual emotional responses many years before the classic symptoms of schizophrenia emerge. Although many symptoms do persist, only a minority of those with schizophrenia have chronic forms. Improvements can and do occur in many cases.

Treatments for schizophrenia involve medications that influence dopamine and other neurotransmitters, as well as rehabilitation-oriented psychosocial treatments focused on social skills, vocational training, and family support and education. The first generation of antipsychotic medications, originating in the 1950s, blocked a certain postsynaptic receptor for dopamine. A new generation of these medications, which can target deficit symptoms as well as psychosis, acts in different ways, on both dopamine and serotonin. One-on-one psychotherapy designed to foster insight has not proven very successful for schizophrenia, but family-based treatments designed to reduce negative interactions and conflict, as well as behavioral interventions intended to promote social and vocational skills, have proven effective. At present, the key objective is on rehabilitation rather than cure. ■

### Suggested Reading

Many psychiatric journals contain the latest research on schizophrenia, including *Schizophrenia Bulletin*. One of the best and most accessible books on the topic is Gottesman, *Schizophrenia Genesis*.

### Questions to Consider

1. How can one tell the difference between rational thinking, thinking that is unpopular or radical, and thinking that is truly irrational and disordered? What standards are helpful in making such distinctions?
2. Schizophrenia involves both psychotic features and negative/deficit symptoms. What are the ways in which each type of symptom is disabling for individuals with this condition?

# Emotion Regulation and Mood Disorders

## Lecture 18

**How to prevent serious mood disorders without taking away a key source of human diversity and human strength is sure to be a major scientific, clinical, and ethical issue in the years ahead.**

**M**ood states give flavor and meaning to the events of our lives. This lecture discusses the differences between normal fluctuations of mood and those implicated in mood disorders, reviews relevant gene-environment interplay, examines outcomes of medication and psychotherapeutic treatments, and probes the fascinating linkages between creativity, productivity, and mania.

We must first differentiate emotions that spanning several seconds; moods, which may last hours, or longer; affective styles; and mood disorders. All humans respond similarly to inherently pleasurable or inherently aversive stimuli with emotion displays of happiness or interest versus sadness, disgust, anger, or fear. Emotion displays span a few seconds in length. There is more universality than cultural relativity regarding emotion. Moods span hours or days. A positive or negative mood state triggers related cognitions and memories. Affective styles are predominant tendencies toward optimistic versus pessimistic appraisals of the world; they undoubtedly emerge from temperamental precursors during the earliest years of life. Mood disorders are syndromes involving multiple symptoms; they yield substantial impairment.

Depression is a term with multiple meanings—it can signify sad or pessimistic mood, as well as a syndrome involving not only a sad mood but altered sleep and appetite, negative thinking patterns, low motivation, self-reproach, and loss of pleasure. A key trigger for a constellation of depressive symptoms is the experience of a loss—departure or death of a loved one, or symbolic losses such as experiencing a failure. Depressions are likely to recur, in a condition called unipolar depression. Once one has had a

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**More women than men attempt suicide, but more men complete suicide.**

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major depression, there is a greater than 50% chance that more episodes will occur. After 2, odds of subsequent depressions are even higher. Depression is surprisingly prevalent, especially in adolescent girls and women; it is a major source of significant life impairment. Depression's costs relate to social support, education and jobs, relationships, and suicide risk.

More women than men attempt suicide, but more men complete suicide, because of their use of more lethal means. Suicide risk is highest when a person is beginning to recover from a depressive episode: The energy is now present to perform the act. In terms of causation, major depression has a moderate heritability—30% for men, 40% for women. Crucially, gene-environment interactions appear to play a key role—e.g., inefficient serotonin genes interacting with child maltreatment or adolescent/young adult negative life events.

Several models for explaining depression have been offered. In psychoanalytic models, depression is the turning inward of the anger one feels in response to the departed person or ideal. In social learning and cognitive models, the emphasis is on low levels of behavioral activation and the negative, ruminative thinking patterns that frequently accompany depressions. Biological models incorporate inefficient or unregulated neurotransmission involving serotonin, norepinephrine, or both. For unipolar depression, medications and specific forms of psychotherapy are both effective in cutting episodes short, and the combination of medication and therapy is optimal.



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**Depression involves not only sad mood but also low motivation and self-reproach.**

Mania is a mood state beginning with expansive, elated mood, which often expands to later stages that involve psychosis, extreme loss of judgment, bankruptcy, impulsivity, and destructive tendencies. When mania occurs, it is highly likely to be followed by additional manic episodes, alternating

with depressions, in a condition called bipolar disorder, or manic-depressive illness. The prevalence of bipolar disorder is lower than that of depression—around 2% of the population experiences this condition, roughly evenly divided between men and women.

The suicide rate in bipolar disorder is incredibly high—without treatment, 50% attempt suicide, and 20% complete suicide. Although nearly all forms of mental illness are associated with lowered social class, as either a risk factor or consequence, bipolar disorder is associated, at least in its early phases, with increased productivity and creativity.

The heritability of bipolar disorder is far higher than that of unipolar depression, around 80%. Multiple genes are likely to be involved, involving biological rhythms and instability of key neurotransmitter systems. Particularly important for mania is heightened reward sensitivity; people have difficulty in stopping their pursuit of ever-higher goals and rewards. For bipolar disorder, mood stabilizing medication are helpful in reducing manic symptoms and, if taken regularly, in decreasing the risk for future episodes. Education for family members, group support, and other psychological treatments are important adjuncts.

Overall, the consequences of poor emotion regulation are highly impairing mood disorders, placing a premium on the future discovery of better means of recognizing and coping with negative, and overly positive, emotions and mood states. Prevention is a key goal. When more specific “risk genes” for severe mood disorders are discovered, there may be dire negative consequences related to eliminating all of those at risk: The genes conferring such risk may also add flavor, insight, sensitivity, and high levels of achievement into our minds and bodies. ■

### Suggested Reading

Jamison, *An Unquiet Mind*.

Keltner, *Born to be Good*.

Solomon, *The Noonday Demon*.

Whybrow, *A Mood Apart*.

### Questions to Consider

1. When does normative grief or loss cross over into major depression, and what are the implications for both evolution and the means of treating either entity?
2. Mania can be associated with creativity and productivity, so perhaps we should not even treat people with bipolar disorder. Is this a defensible statement; why or why not?

# Attention, Impulse Control, and ADHD

## Lecture 19

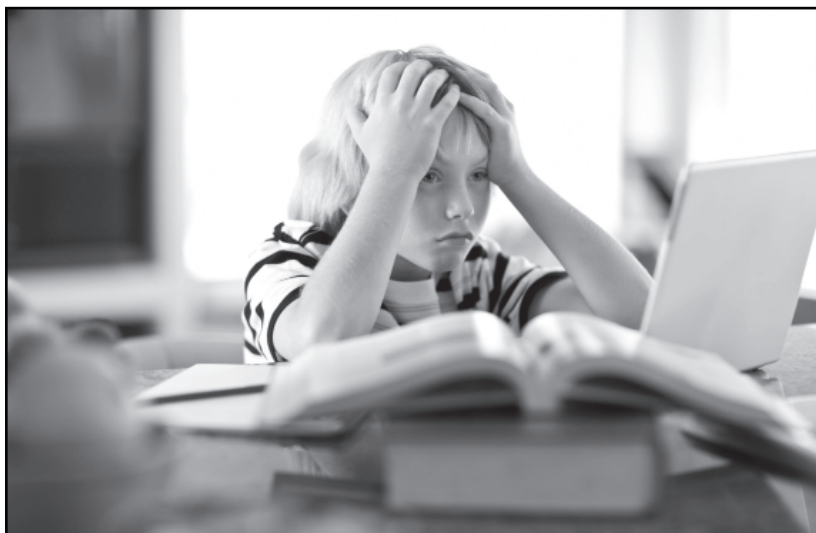
**Even for conditions with quite strong heritability, like ADHD, changes in the environment—the home environment, more consistent discipline—can still lead to better outcomes.**

**A**ttention is a mental spotlight on the many internal and external stimuli competing for your interest. Inhibitory control allows us to stop previously rewarded responses and choose new plans of action. There are several types of attention.

- Automatic attention occurs when we are unconsciously attracted to a salient stimulus, which may facilitate fight-or-flight responses.
- Selective attention pertains to situations in which we choose between competing stimuli (listening to the lecture or thinking of dinner).
- Sustained attention is the ability to maintain focus for long periods, despite the tendency to fade and become distracted.
- Executive attention is the intentional mustering of energy and cognitive resources to perform difficult tasks.

Attentional capacity/load is related to just how much information we must hold in mind at a given time. Inhibitory control is necessary to delay our response to a stimulus, allowing one to evaluate what to do and plan for alternative courses of action.

Evolution clearly favored the ability for individuals to select the most “pressing” situation at hand and devote cognitive resources to it. Across human evolution, an advantage would exist when some individuals tend to display excellent focus and a deliberative cognitive style whereas others display quicker abilities to scan the environment and/or multitask. Genes that are related to attention, focus, and sensation seeking have several alleles,



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**Children with ADHD are likely to have problems in school and achievement, even if they do not have learning disabilities.**

some of which promote greater focus and others of which are associated with a more impulsive style. In contemporary society, however, especially with the advent of compulsory education in the past 150 years, poor focus is a real liability.

In modern society, it has long been recognized that high levels of inattention, impulsivity, and hyperactivity are maladaptive. The terms for clinical conditions related to poor focus have shifted from moral defects to minimal brain dysfunction (MBD), hyperactivity, hyperkinesis, ADD, and most recently, attention-deficit/hyperactivity disorder (ADHD). Diagnosis requires extremely high levels of these features, from an early age, in multiple situations, unrelated to recent stress. Prevalence is 6–8% of the school-aged population, which is similar in most nations with compulsory education. As with all other early-onset conditions, boys outnumber girls, by about 3:1. Two main types exist: youth or adults with predominant inattention, and those who display hyperactivity/impulsivity as well.

ADHD persists into adolescence and adulthood in a majority of cases. There are high rates of associated aggression, anxiety, learning problems, and, by adolescence, substance abuse and delinquency. For girls, eating problems and depression are common.

ADHD is strongly heritable and is related to other biological risk factors. The heritability for this condition is 70–80%; higher than that for schizophrenia or depression and comparable to that for bipolar disorder. As for psychosocial factors, there is little evidence that parenting per se is a causal factor, and there are no elevations of insecure attachment in infants who later develop ADHD. Still, disruptions in parenting and home life may result from having a child with ADHD, and negative, harsh, or lax parenting may well exacerbate the condition. Reciprocal, transactional models are clearly operative: A child with difficult temperament elicits negative responses from parents, fueling symptoms and related problems. Given ADHD's heritability, it's not uncommon for biological parents to have the syndrome themselves, whether or not diagnosed.

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**ADHD persists  
into adolescence  
and adulthood in a  
majority of cases.**

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Treatments include stimulant medications and behavioral strategies implemented at home and at school. Why would a child or adult with ADHD respond to a stimulant? It was once thought that the response was paradoxical, but it is now known that all humans respond to low doses of stimulants, which are dopamine agonists, with increased focus. Over time, however, there can be risk for addiction in adolescents and adults, so stimulants need close monitoring. Considerable debate is occurring over the use of many medications as performance enhancers for the body or mind.

Medication treatment for ADHD is quite effective for most individuals, but effects are short-lived and the optimal results occur when medications are combined with reward-based behavioral programs implemented at home and school. When medications and behavioral treatments are combined, children who show the largest gains are those whose parents have changed their parenting strategies toward an authoritative style—less harshness, greater consistency. ■

## Suggested Reading

Barkley, *Attention Deficit Hyperactivity Disorder*.

Hinshaw, *Attention Deficits and Hyperactivity in Children*.

Mayes, Bagwell, and Erkulwater, *Medicating Children*.

## Questions to Consider

1. What are the key advantages and disadvantages of having an attention system that is quick to shift directions, marked by impulsivity and distractibility? Is this a disability or a potential strength?
2. Given that ADHD is not solely an American phenomenon, why is medication use for this condition so much higher in the United States than elsewhere?

# Empathy, Social Connections, and Autism

## Lecture 20

**For a complex, social species, and one that could need many hands on deck to evade predators and form bonds and bands, “reciprocal altruism” indeed makes sense. This isn’t pure sacrifice but is a kind of tit-for-tat, or a planned trade or share of goods, services, or helpful behaviors.**

**S**ocial connections and empathy are foundations of humanity. In human evolution, our species couldn’t have survived and reproduced without a strong penchant for social behavior. Empathy can be divided into emotional empathy, taking on the feelings of others, and cognitive empathy, understanding those feelings in others.

Between 3 and 5 years of age, humans develop theory of mind, the ability to understand that other people may have different perspectives than oneself. Even children with mental retardation “pass” theory of mind tests at the correct chronological or developmental age. But if you couldn’t develop this ability, or could only do so through laborious mental efforts, the social world would be a confusing place, indeed. This may well be a core deficit of the condition we call autism, as even high-functioning individuals with autism fail theory of mind tasks. Evolutionary psychologists posit that theory of mind is a discrete mental module, but others contend that it may emerge from relationship quality as well.

Autism was discovered in the 1930s and 1940s as a disorder beginning in the earliest years of life, involving 3 core deficits. Language problems and delays: Some autistic individuals never learn to speak, whereas others have language oddities, such as repeating precisely what’s just been said, or extremely focused conversations about restricted topics. Social isolation and difficulty bonding with others: Parents report that, during the first months of life, many children with autism recoil from being held. Eye contact is poor, and many youth with autism appear to use others as objects rather than real people. Repetitive play and need for preservation of sameness: Autism



is marked by extremes of behavioral rigidity, with some children throwing violent tantrums to any alteration in schedule or routine.

Whereas most youth with autism function intellectually in the mentally retarded range, a subgroup has “high functioning autism,” with good language skills. This group is sometimes defined as having Asperger’s disorder. Case studies exist where autistic savants have incredible memory, musical, or mathematical calculation abilities. Despite media popularization, such individuals appear to be relatively rare. Longitudinal studies reveal that autism is rarely outgrown, although some individuals with high-functioning autism can lead semi-independent lives.

Claims abound that autism is skyrocketing in prevalence. Data from the past 10 years indicate that rates have tripled in some venues. Is there a true increase in prevalence? This is highly unlikely. Rather, a spectrum of autism and other pervasive developmental disorders are now diagnosed far more than ever before, because of the visibility of the condition and its established nature in helping to procure special school services.

One provocative idea is the Silicon Valley Syndrome, whereby 2 parents, each with well developed mathematical and spatial abilities but rather poor social skills, mate and produce offspring with heightened genetic risk. What are the causes of this mysterious condition? Heritability is as high as that for any psychiatric condition, as high as 90%. There may be other biological risk factors in utero that accentuate or potentiate the genetic risk.

Contrary to original views that faulty parenting produced autistic reactions in children, in many cases the symptoms are present in the earliest months of life; many children with autism actually show secure attachment; and a quarter of children with autism will develop seizures by adolescence or early adulthood, clearly signifying neurological rather than psychological roots.

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**The most documented intervention strategy for autism is intensive, in-home behavioral interventions emphasizing rewards and skill-building.**

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A subset of children with autism appear to develop normally during the first year of life but then regress significantly during the second year. For them, head circumferences may be overly large, possibly signifying that an underlying mechanism is a failure in neural pruning—leading to large but inefficient brains. As noted above, even high-functioning children with autism do not “pass” theory of mind tests by age 5, signifying that autism may relate to a specific deficit in perspective taking.

The most documented intervention strategy for autism is intensive, in-home behavioral interventions emphasizing rewards and skill-building, for at least 20 hours per week, during the preschool years. Although initial claims that such treatment would cure autism in 50% of cases were overstated, early stimulation, training, and rewards can help establish language, cognitive, and behavioral skills that may allow for regular education. ■

### Suggested Reading

Grandin, *Thinking in Pictures*.

Offit, *Autism's False Prophets*.

Sigman and L. Capps, *Children with Autism*.

### Questions to Consider

1. Why does it make psychological and evolutionary sense that some of us are gregarious whereas others are far more socially withdrawn isolated?
2. At what point on the continuum of social relatedness and linguistic ability should we consider diagnosing an individual with a condition like autism—in other words, how stringent should the diagnostic threshold be?

# Evolution and the Paradox of Mental Illness

## Lecture 21

**It appears that 1/4 of the world's population is affected with moderate to severe forms of mental illness in any given one-year period.**

What we have learned about mental illness appears to convey a large mystery or paradox. Mental disorders are distressingly prevalent, existing as long as human history has been recorded, with its major forms found in every culture on Earth. Overall, moderate to severe mental disorders affect at least a quarter of the world's population. Mental illnesses are highly impairing. Their core symptoms eat away at the most productive years of life, erode healthy identities, affect school and work performance, devastate families, cost the world economy untold billions of dollars each year, and lead to huge personal suffering.

The major forms of mental disorder are moderately to strongly heritable. Major depression has a heritability of 30% in males and 40% in females; the heritability of schizophrenia approaches 60%; ADHD, 70–80%; bipolar disorder, 80%; and autism, nearly 90%. It is important to note that the genetic predisposition to mental disturbance exists on a continuum.

How can mental illnesses be this prevalent, this impairing, and this heritable—and still have persisted across generations? Shouldn't they have bred themselves out of existence? A close look at key principles of genetic theory and evolutionary theory can help to resolve this apparent paradox. The first answer lies in the concept of heterozygote superiority. Certain genes come in 2 forms, one dominant allele, capital D, and one recessive allele, small d. The dominant allele, when present, produces the phenotype; the recessive “carries” the phenotype only when there are 2 copies of it.

Because we all carry 2 alleles of each gene, 1 inherited from the mother and 1 from the father, an individual can be a dominant homozygote (DD), a recessive homozygote (dd), or a heterozygote (Dd). In some cases, the recessive allele of the gene conveys risk for disorder, but heterozygotes have a particular advantage. Thus, carriers or heterozygotes have a

selective reproductive advantage, which outweighs, at a population level, the disadvantage that pertains to rare homozygotes. The recessive allele persists in the population because of heterozygote superiority. What is the pertinence to mental illness? Even though no mental disorders are dominant or recessive, the same principle doubtless applies: Those with partial risk may have particular advantage.

The second answer has to do with the effects of genes. Genes exert complex effects, through gene-gene interactions or gene-environment interactions. A single gene may or not be a risk gene, depending on the surrounding genotype or surrounding environment.

The third answer is that the genes from our genetic heritage, which may have been quite adaptive during earlier parts of human evolutionary history, are no longer adaptive given the current environments in we find ourselves.

Overall, evolution and natural selection provide fresh and important perspectives on reasons for the apparent paradox of the continued presence of heritable, highly impairing mental illnesses. The paradox posed at the beginning of this lecture may actually not be so paradoxical. ■

### Suggested Reading

No book-length account of this topic yet exists, but for some examples see Andreassen, *Brave New Brain*, and Hinshaw, *The Mark of Shame*.

### Questions to Consider

1. What are some of the traits or behavior patterns that may have been adaptive in earlier stages of our species' history but are now considered maladaptive or even signs of mental disorder?

**Genes from our genetic heritage, which may have been quite adaptive during earlier parts of human evolutionary history, are no longer adaptive.**

2. Why is the concept of heterozygote superiority significant for understanding the surprising persistence of mental illness throughout human history?

# Roots of Religion, Aggression, and Prejudice

## Lecture 22

As many of you dog owners undoubtedly know, some dogs and dog breeds are neurotic, some are quite extraverted; they can also differ quite a bit on agreeableness versus hostility. This underscores the point that evolution tends to preserve key structures and functions across species.

**T**his lecture features evolutionary perspectives on 3 key issues related to the human mind: the overwhelming tendency for humans to have religious beliefs, the levels of human aggression that exist, and the strong proclivity to stigmatize fellow humans with physical and behavioral differences. We discuss the core human tendency to show prejudice, discrimination, and stigma toward those with different skin colors, national origins, or behavioral patterns than our own. Exclusion modules in our minds may have developed in order to prevent runaway social bonds.

Humans have an overwhelming tendency to believe in supernatural powers, to posit a creator, and to hold religious beliefs. All known societies have been permeated with religion. Even in modern America, over 90% of the general public professes belief in higher powers. From an evolutionary perspective, capacities related to religious beliefs include symbolic communication; language and narrative; a sense of continuity between past, present, and future; the tendency to attribute causes and intentionality to events in the world; the ability to ascribe mental states to others; and perhaps the ability to experience emotions like awe.

Can we consider religious beliefs and practices as a true adaptation? Or are they a by-product related to theory of mind, agency attributions, or symbolic skills emerging in early humans? In the early 21<sup>st</sup> century, controversy accompanied the hypothesis that there is a specific “God gene”—that is, a specific mutation, which spread, creating belief in higher powers. It is unlikely that any 1 gene underlies such complex beliefs.

Other views include the perspective that religion emerged from primates' intense attachment bonds with early caregivers, fueling empathy and a deep need for belongingness; and the assertion that, over time, humans have created deistic entities less vengeful and more compassionate as the result of social structures favoring cooperation. A fundamental debate centers humans social behavior: Are humans fundamentally good, helpful, and prosocial, but swayed by modeling, learning, and even the media to be selfish and aggressive?

Social learning views emphasize the learned nature of aggression; psychodynamic perspectives feature their instinctual basis. There are pervasive human tendencies to expand into new territories, impose the victorious group's will on and enslave those groups who are vanquished, and disrupt the natural environment severely. But we also negotiate to meet our needs, rather than throw our weight around.

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**Social learning views  
emphasize the learned  
nature of aggression.**

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Developmentally, the most aggressive members of our species, in terms of the sheer number of aggressive acts, are 1–2 year olds!

It is not that some children start to display aggression during the preschool years, but rather a small percentage of youth, about 5% of boys and 1% of girls, fail to develop brakes on aggression. Whatever the ultimate roots of human aggression, if our species is to continue to evolve, some better ways of curbing aggression must be enacted.

What are the roots of human diversity? Humans living closer to the equator were advantaged if they carried genes that protected them from the Sun's intense ultraviolet rays—that is, if they were able to produce enough melanin to have a darker skin color. When humans migrated to northern latitudes, mutations allowing more vitamin D to enter the body supported lighter skin color. Personality traits in humans emerged from similar traits in other mammals; we have been selected for variability in such traits.

Despite advantages that accrue from diversity and despite the deeply ingrained tendencies for humans to be social and gregarious, there are naturally selected limitations on indiscriminate sociability. If humans are



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**Some children start to display aggression during the preschool years.**

indiscriminately social, they may become infected or infested—or exploited, falling victim to those from hostile “outgroups.” There is therefore strong likelihood of a core tendency for humans to reject, withdraw from, punish, and stigmatize those whose behaviors signal “outgroup” status.

Stigma is a term from ancient Greece signifying a literal brand or mark placed on traitors or slaves. Today’s meaning is more psychological, incorporating stereotypes, prejudice, discrimination, and a global branding of all negative attributes of an individual to group status. The most stigmatized attributes in current society are homelessness, substance abuse, and mental illness. It would appear that simply attributing mental illness to a medical or genetic model would greatly reduce stigma. However, evidence exists that such attributions may actually fuel punitive responses. Communicating the interactive influences on behavioral diversity—and framing diversity in terms of narratives and life stories—may be an antidote to such tendencies to dehumanize and stigmatize. ■



## Suggested Reading

King, *Evolving God*.

Lorenz, *On Aggression*.

Thornicroft, *Shunned*.

Wright, *The Evolution of God*.

## Questions to Consider

1. What are the evolutionary bases of both religious beliefs and aggressive behaviors—and what are the cultural, learned components of each?
2. Why would attributing mental illness to deviant genes lead, paradoxically, to harsh rather than empathic responses from fellow humans?

# Bringing in Personal Narratives

## Lecture 23

**William Beardslee, at Harvard Medical School, has devised a particular form of family therapy specifically in cases where one or both parents has a mood disorder. The main feature of this therapy involves creating a narrative to tell the child.**

Science related to the human mind and human behavior has made great progress, but there is risk for its becoming an amalgamation of dry facts and findings unless it is balanced by narrative accounts of the life experiences of people who are subjects of research studies or who are treated for psychological distress.

A life narrative is a story of an individual's existence with a beginning, a middle, and an end. A host of such narratives have emerged in recent years, some that are first-person accounts and others that are sensitive and vivid case portrayals. These narratives help humanize mental and neurological disorders, and can reveal the potential for strength and resilience in our species. Indeed, humans are characterized by grammatical language and story-telling skills, revealing the mythic nature of our species, per Merlin Donald. Narrative places scientific variables and theories in a humanistic perspective.

**Contemplating and writing about personal experiences has additional benefits for the writer as well.**

Contemplating and writing about personal experiences has additional benefits for the writer as well. Compared to writing equally-long passages about pleasant events or about neutral events, writing about negative events may help to prevent illnesses and to produce greater levels of psychological adjustment.

My father had a rich, troubled, and sometimes harrowing life; a brief account may be instructive with regard to humanizing severe mental illness. Born in 1919, Virgil Hinshaw Jr. was the youngest of 4 brothers; his mother was a missionary and his father was a Prohibitionist. His family history

included both high achievement and cases of mood disorder, anxiety, and substance abuse.

He lost his mother at age 3, and several years later, his stepmother engaged in a pattern of physical and sexual abuse. Even so, his childhood was marked by high academic achievement, athletic success, and a dedication to church. At age 16, in a period of mania, he jumped from the roof of the family home. For the next 6 months, he was chained to a bed in a public mental hospital. Still, without treatment, he recovered and went on to become high school valedictorian. His lasting diagnosis was schizophrenia, despite a clear pattern of repeated manic and depressive episodes.

Despite academic success at Stanford and Princeton, and a budding career as a philosopher, he had additional, severe episodes. He became a professor at Ohio State, but his wife's pregnancies triggered serious episodes of mania and depression during the 1950s and 1960s.

His doctors told him to “never tell your children about mental illness”—so the family was enshrouded in silence. In between episodes and absences, he was a generous and loving father. Only when I went away to college did my father begin to disclose his life's story. Not surprisingly, I gravitated toward psychology, the study of the mind, and toward work with children. I helped my father gain a correct diagnosis of bipolar disorder, 40 years after his initial episode. Near the end of my father's life, I wrote a narrative account of his life. This brief narrative raises several key themes and lessons:

- Accurate diagnosis of mental disorder is crucial in obtaining evidence-based treatment.
- Both biological/genetic risk and life circumstances are necessary for mental disorder to emerge.
- Resilience and courage are indeed possible in the face of serious risk.
- Open discussion of family problems and secrets is essential—if done in ways that are sensitive to the age of the child—to prevent shame, silence, and internalization.

- Disclosure and narrative can help to replace negative stereotypes with compassion, understanding, and a desire to learn more and develop effective treatment and rehabilitation programs.
- Finding ways to reveal and share experiences may also be a key means of overcoming prejudice and stigma, opening all of us to the diversity and potential of the human species and the human mind.

My continuing goal is to blend rigorous science with humanizing personal and family narrative. ■

### Suggested Reading

Hinshaw, *Breaking the Silence*.

———, *The Years of Silence are Past*.

Jamison, *An Unquiet Mind*.

### Questions to Consider

1. Why might writing about or sharing one's personal narratives, particularly emotionally troubling ones, produce benefits to physical and emotional well being?
2. How can individuals with severe mental illness show strength, courage, and resilience, defying our stereotypes of mental disorder?

# The Future of the Human Mind

## Lecture 24

**Overall, in many ways, the origins of our minds via evolution and the origins of each mind during individual development are quite closely linked, and the science related to this integration is increasing in sophistication and power each year.**

**T**his course has provided a tour of the origins of the human mind at 2 levels: on an evolutionary scale and through each individual's developmental path. What will the continued study of the human mind entail in terms of new frontiers? It is hard to provide valid guesses given the fast pace of progress; but the following are leading contenders: Many more mental and emotional processes take place at unconscious levels than previously thought. Artificial intelligence and the growth of computers could either enhance our well-being or threaten the existence and viability of the human mind. The study of human consciousness is now a viable area of investigation. The ever-growing potential for us to engineer our own minds, and our own evolution, is one of the greatest and most controversial frontiers for our species. The linking of the mind with broad social issues is another key frontier.

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**The study of human consciousness is now a viable area of investigation.**

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Will future investigations of the mind be used for good or for ill? The same question has been asked about physics, with respect to our understanding of the nature of the atom and of the universe; about genetics and genomics, with respect to engineering our own life blueprints, DNA; and about the inner workings of our unique human consciousness.

Perhaps the key question is how to maintain ethical control over our ever-changing discoveries related to the science of the brain and mind, including the emerging field of neuroethics. Overall, a fundamental dualism between objective, naturalistic accounts of the mind and subjective, narrative portrayals reveals a key tension in the sciences and humanities. ■

## Suggested Reading

Hawkins and Blakeslee, *On Intelligence*.

Kurzweil, *The Singularity Is Near*.

## Questions to Consider

1. With the very real potential for super-intelligent computers and for intentionally directing our own evolution through genetic manipulation, what will it mean in the future to be human?
2. What is your list of the key issues that will confront those interested in the human mind in the coming years?

# Timeline

## A. Integrative Timeline of Prehuman and Human History

### Part I: Prehuman History

Key: Ma = Millions of years ago

Ka = Thousands of years ago

Ya = Years ago

Note: Entries in bold are not directly on the “path” to modern humans. They are included to reveal patterns of convergent evolution in different evolutionary trajectories, during natural selection.

Time	Species	Neuronal/ brain Features	Some functional capacities
590 Ma	jellyfish	While no brain, neurons form in epidermis in a “nerve net.”	Basic sensation and motor response.
550 Ma	segmented worms	Brain consisting of ganglia and cords, with giant axons; some have rudimentary forebrain, midbrain, and hindbrain.	Detection of light, chemicals, and contact; withdrawal of body from danger.

Time	Species	Neuronal/ brain Features	Some functional capacities
525 Ma	vertebrates	All house brain inside cranium with brainstem; even early vertebrates have forebrain, midbrain, hindbrain; neurogenesis, synaptogenesis, and some myelination occur	Regulation of body functions, sexual behavior, and locomotion.
400 Ma	<b>insects</b>	Brains with capability for perceiving sounds and scents; neurogenesis, synaptogenesis, and myelination occur.	Flying, highly organized societal structures in some species; perception of social “dance” signals in honeybees.
375– 450 Ma	jawed vertebrates	Greatly increased myelination.	Faster neural transmission; able to eat larger prey, with increased energy stores.
325 Ma	reptiles	Limbic system.	Rage, fight-flight responses.
180 Ma	mammals	Neocortex, 6-layered dorsal region.	Social bonds, rudimentary problem solving, and better memory.



<b>Time</b>	<b>Species</b>	<b>Neuronal/ brain Features</b>	<b>Some functional capacities</b>
150 Ma	<b>birds</b>	Well-developed cerebellum and visual system.	Some species begin learning song and memory of migration routes; dimorphisms in brain, seen relating to male song patterns
120 Ma	placental mammals	A wider pelvic opening in females allows the birth of young with larger brains.	Enhanced problem-solving.
55–65 Ma	primates	Enhanced cerebellum, thicker cortex, and a larger brain.	Motor coordination; stereoscopic vision; and single births, leading to a slower period of individual development.
20 Ma	upright primates	Larger frontal cortex.	Bidepalism, more intensive social bonds, and more use of opposable thumb.
7 Ma–present	chimpanzee	Brain size 350 cm <sup>3</sup> .	Use of natural stones as tools; urge to play; display some empathy; episodic skills salient.

\*Note: Hominid separation from lineage with chimpanzees: 5–7 Ma.

Time	Species	Neuronal/ brain Features	Some functional capacities
4–5 Ma	<i>Ardipithecus ramidus</i>	Brain size 350 cm <sup>3</sup> .	Less aggressive than chimps with less pronounced canine teeth; apparently lived in both trees and on ground.
3–4 Ma	<i>Australopithecus afarensis</i>	Brain size 475 cm <sup>3</sup> .	Possibly split stones as tools; episodic skills salient. It's unclear if <i>Australopithecus</i> is direct ancestor of <i>Homo sapiens</i> .
1.6– 2.5 Ma	<i>Homo habilis</i>	Brain size 630 cm <sup>3</sup> .	Use of chopper tools but no teaching or innovation, tools stayed much the same for the duration of the species; mimetic skills more salient.
2 Ma– 150 Ka	<i>Homo erectus</i>	Brain size 1000 cm <sup>3</sup> .	More complex tools, like hand ax, but still no teaching or innovation within this species; speech apparatus with more clarity; mimetic skills salient.
500 Ka– 28 Ka	Neanderthal	Brain size 1500 cm <sup>3</sup> .	Even more complex tools, like spears and limited teaching and innovation; speech apparatus with more clarity; mimetic skills salient and beginnings of mythic skills.

Time	Species	Neuronal/ brain Features	Some functional capacities
150 Ka– present	<i>Homo sapiens</i>	Brain size 1350 cm <sup>3</sup> .	Ever more complex tools, including ornamented knives and spears, all the way to agricultural instruments and metal weapons; much teaching and innovation through the development of human culture; speech apparatus fully developed; mythic skills fully realized.

## Part II: Advances for *Homo sapiens*

125,000 Ya .....	Earliest evidence of burial rituals, assuming a belief in an afterlife.
80,000 Ya .....	Early art in the form of symmetrical scrapings on tools.
60,000–75,000 Ya .....	Modern humans migrate out of Africa.
30,000 Ya .....	Advanced cave art, modern hunting tools, more elaborate burial rituals, and evidence of musical instruments. Positive selection pressure for genes related to brain development.
10,000 Ya .....	Evidence of agriculture, animal domestication, and permanent settlements. Positive selection pressure for genes related to skin color,

lactate production, and, potentially, brain complexity.

6000 Ya .....	Systematic written symbols appear; writing develops theoretic skills.
2000–4000 Ya .....	Modern cultures in Egypt, Greece, China, Africa, and the New World.
600 Ya .....	Printing press invented.
150–200 Ya .....	Industrial Revolution.
50–60 Ya .....	Modern computers invented.

## B. Timeline of Individual Development

Developmental “Era”	Behavioral and Brain Developments
prenatal.....	Massive neurogenesis and initial synaptogenesis; a brain at birth contains well over the adult complement of 120 billion neurons. Around 2 weeks, the neural plate develops. At 4–5 weeks, the neural tube begins to separate into hindbrain, midbrain, and forebrain, and the neural groove, forerunner of spinal cord, at 5–6 weeks. By 1–2 months the brain stem and the medial forebrain bundle begin to form. The limbic system, thalamic nuclei, and hippocampus form around 2–3 months. The cerebellum and

corpus callosum form at 3–4 months. Cortical neurons form during first third of prenatal development, but particular regions migrate more slowly. Around 5 months, we respond to light, when eyes are open; and around 5–6 months we respond to sound. Myelination occurs from 7 months until well after birth, extending through adolescence in some regions; portions of prefrontal cortex are last to myelinate. Many more convolutions develop between 7–9 months in the frontal cortex, but the region does not fully mature for over 20 years.

- infancy (0–1 year).....Myelination continues rapidly, speeding up neural transmission; massive synaptogenesis and pruning. Several infant reflexes and temperamental features emerge; attachment security or insecurity develops; Piaget’s sensorimotor stage of development.
- toddlerhood  
(1–3 years) .....Continuing synaptogenesis and pruning occurs; language explosion occurs.
- early childhood/  
preschool (4–5 years).....Theory of mind fully emerges; peer relationships multiply; Piaget’s preoperational stage of development.
- middle–late childhood  
(6–10 years) .....Intensive growth of academic skills; cortical “thinning” normatively occurs; Piaget’s concrete operational stage of development.

early adolescence (11–15 years) .....	Sexual maturation/pubertal development; further frontal development takes place, but cognitive skills outpace risk-taking tendencies; Piaget's formal operational stage of development.
late adolescence (16–19 years) .....	Push toward independence, but frontal maturation is still not complete; myelination finally completed in some frontal regions; cognitive maturation; peak or near peak in many perceptual-motor skills.
young adulthood (20–39 years) .....	Full maturation of frontal lobes; if used, verbal skills continue to develop; new families emerge; intimacy and commitment issues salient; responsiveness and sensitivity to offspring predicts security.
middle adulthood (40–69 years) .....	Gradual declines in motor skills; time of life during which engagement in mental and physical activities appears crucial for maintenance of cognitive functioning.
older adulthood (70+ years) .....	Socioemotional selectivity theory (SST) comes into play.

# Glossary

Terms are defined briefly, with reference to this course; complete definitions may be beyond the scope of this glossary in many instances.

**action potential:** Brief electrical signal related to changes in a neuron's membrane potential; produces a nerve impulse.

**additive model (of behavior genetics):** The model contending that individual differences in traits or behaviors are attributable to genetic factors, shared environmental factors, and non-shared or unique environmental factors, all of which are independent of one another.

**adolescence:** Developmental period beginning at the time of puberty/sexual maturation; the end point is harder to pinpoint (e.g., development of independence from family of origin).

**adoption studies:** Method of inferring heritability in behavior genetics research, through comparing rates of a trait or disorder in biological versus adoptive relatives.

**affective style:** Individual's emotional tone for long periods of time, probably related to vestiges of early temperament.

**agreeableness:** One of the Big Five personality traits, linked to social warmth, empathy, optimism, and absence of hostility.

**alleles:** Variants of a given gene, with 1 form inherited from each parent.

**amygdala:** Almond-shaped subcortical nucleus; linked to basic emotions, especially fear.

**antipsychotic medications:** Psychoactive medications used to treat psychosis and schizophrenia; first-generation formulations blockade the

postsynaptic dopamine receptor; second-generation formulations have more complex actions on dopamine, serotonin, and other neurotransmitters.

***Ardipithecus ramidus***: A primate species, living between 4 and 5 million years ago. Thought to be a forerunner of *Australopithecus afarensis* (“Lucy”); an intermediate between chimpanzees and modern hominids. Speculation is that this species lived both in trees and on the ground.

**artificial intelligence (AI)**: Machine-based, computer intelligence. *See* Turing test.

**Asperger’s disorder**: Synonymous with high-functioning autism, in which an individual has normal intelligence, yet social oddities and idiosyncratic speech dominate the clinical picture.

**attachment**: The naturally selected processes of parent-child bonds in primates; individual differences in human attachment are assumed to relate to parental responsiveness to infants during the first year of life.

**attention**: Crucial mental process, akin to a “spotlight,” signaling which stimuli the individual should focus on. Important subtypes include automatic attention, selective attention, executive attention, and sustained attention.

**attention-deficit/hyperactivity disorder (ADHD)**: Mental disorder characterized by extremes of inattention, impulsivity, and hyperactivity; originates in childhood; treated with stimulant medications and/or behavior therapy.

**attribution**: An individual’s causal explanation for an event or occurrence.

***Australopithecus afarensis***: Primate species living approximately 3–4 million years ago; assumed to be a direct ancestor of hominids and modern humans, perhaps having descended from *Ardipithecus ramidus*. Lucy is the name of the complete female skeleton.



**authoritarian parenting:** Style marked by high levels of control/demands but low levels of warmth/responsiveness; associated with overcompliance or aggression, but not in all ethnic groups.

**authoritative parenting:** Style marked by high levels of both warmth/responsiveness and control/demands; associated generally with good academic and social outcomes.

**autism/autistic disorder:** Mental disorder with origins early in childhood, marked by social isolation, language difficulties and abnormalities, restricted play, and a need for order and sameness.

**autoreceptor:** Receptor for the neurotransmitter of a neuron located on the axon of that same neuron; stimulation of autoreceptor usually serves to slow synthesis of that neurotransmitter.

**axon:** Long “arm” of a neuron, carrying signals down its length to the synapse.

**Baldwin effect:** Hypothesized mechanism of natural selection in which general learning abilities are favored as adaptations.

**behavior genetics:** Field of study to infer genetic, or heritable, versus environmental contributions to individual differences in traits and conditions; major research methods include family studies, twin studies, and adoption studies.

**behavior therapy:** Application of principles of classical and/or operant conditioning to mental disorders, such as phobias, depression, ADHD, and schizophrenia.

**Big Five personality traits:** Commonly accepted structure of adult personality, captured by acronym OCEAN representing 5 core traits: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism.

**bipolar disorder:** Severe mood disorder with alternating periods of depression, mania, and mixed states (combining manic and depressive features). Highly heritable; highly associated with risk for suicide, if untreated. Formerly termed manic-depressive illness.

**blindsight:** The implicit ability to “see” without conscious perception of objects.

**case study:** Research method involving intensive investigation of a single individual; leads to rich information but may be subject to non-representativeness and lack of control of extraneous variables.

**cerebellum:** Large area above brain stem linked to motor coordination, timing of actions, and learning.

**classical conditioning:** Form of learning in which unconditioned stimuli, which trigger an involuntary response, are paired temporally with conditioned or neutral stimuli, such that the conditioned stimuli come to evoke the initial response.

**cognition:** Processes of thinking; specifically, in cognitive science, refers to information processing models of the mind.

**cognitive-behavioral therapy/cognitive therapy:** Updated versions of behavior therapy, whereby cognitive processes and not just learned behaviors are the subject of active modification.

**cognitive control:** *See executive functions.*

**cognitive map:** Tolman’s concept that even mice and rats learn a maze form a visualization of the maze; thus, learning can occur without reinforcement.

**cognitive psychology:** Product of cognitive revolution of the 1950s and beyond, the study of mental processes as underlying much of human behavior: perception, memory, higher-order abstract thinking, and the like.

**concrete operational stage of development:** Third stage of Piaget's model of cognitive development when children become able to reason logically about concrete events and objects, approximate ages 7–12.

**connectivity:** Patterns of synaptic linkages in the brain; high levels of connectivity are found in human brains.

**conscientiousness:** One of the Big Five personality traits, linked to achievement-orientation, carefulness, reliability, and deliberation.

**consciousness:** Subjective awareness, knowledge of self, and meta-awareness—that is, awareness of one's awareness; the subject of renewed scientific efforts related to gaining an understanding of how human self-awareness evolved.

**correlational research:** Method of appraising whether one variable is associated with another; commonly used in research on the human mind, when experimental control is not possible.

**cortex:** The outermost layers of our cerebral hemispheres; also known as “grey matter” because of accumulations of cell nuclei.

**cranium:** The skull; fossilized craniums are essential for inferring brain size.

**critical period:** Developmental “window” during which, if a psychological process does not take place, it will be too late afterwards. *Contrast with sensitive period.*

**cultural evolution:** Processes, in recent human history, of gains in human skill through means other than natural selection.

**culture:** A system of shared beliefs and values, transmitted by social groups to their members, shaping and guiding perceptions and behavior.

**defense mechanisms:** In psychoanalytic theory, the unconscious mental processes that mask the underlying conflicts, to ward off anxiety. Examples include denial, repression, projection, introjection, and sublimation.

**delusion:** A fixed, false belief that is extremely resistant to rational argument; a symptom of psychosis.

**dendrite:** Postsynaptic end of neuron; receives chemical input from axon terminal of presynaptic neuron via receptors.

**depression:** Mood disorder marked by a sad mood, despair, cognitive distortions, hopelessness, sleep and appetite disturbance, and suicidal thoughts; episodes tend to repeat across the lifespan.

**depressive realism:** Tendency for individuals with depression to not show positive illusory bias, with grim but accurate perceptions of personal deficits.

**developmental gene:** A gene that activates key processes during prenatal or early childhood phases of life, triggering a cascade of developmental processes. *See also* **evo-devo**.

**developmental psychopathology:** Field of study integrating normal developmental processes and atypical behavior patterns.

**diffusion tensor imaging (DTI):** An imaging technique allowing appraisal of the white-matter tracts of the brain; used to infer connectivity.

**disorganized attachment:** Individual difference in attachment security; child has no consistent response to parent's return after absence, engaging in disconnected, freezing behavior; believe to result from frightening, abusive parental behavior.

**DNA (deoxyribonucleic acid):** Complex double-helical molecule, found in the nucleus of every cell, that contains the genetic code for life; divided into chromosomes, genes, and non-genetic material.

**dopamine:** Key neurotransmitter related to attention, reward, voluntary motor movement, and higher cognitive function.

**dualism:** Belief that mind and body are different entities, which cannot be reduced to each other.

**effortful control:** Temperamental characteristic emerging near the end of the first year of life, related to increasing ability to regulate attention and sustain attempts to manipulate the environment.

**emotion:** Action tendency and feeling state, motivating and organizing an organism; composed of physiological, subjective, and facial components; a number of basic positive and negative emotions have been identified cross-culturally.

**emotion regulation:** Means of modulating or responding to one's emotions; major subtypes include reappraisal of emotion-eliciting situations or suppression of emotion displays. Begins during the first year of life as self-soothing; becomes increasingly sophisticated with maturation of frontal lobes and internalization of social input.

**empathy:** The sharing or matching of emotions with another person; subdivisions include emotional empathy or emotion matching and cognitive empathy.

**empiricism:** Philosophical contention that knowledge emanates from experience and evidence; thus, the mind is a blank slate at birth, with learning accounting for the human mind.

**epigenetic factors:** Broadly speaking, changes in gene expression for reasons other than actual alterations of genetic code.

**episodic skills:** First stage of prehuman cognitive development, per Merlin Donald, in which extensive memories guide adaptive behavior.

**evo-devo (the evolution of development):** Subfield of evolutionary theory dealing with genes expressed early in development, even prenatally; such genes alter developmental processes to create novel structures and functions. More generally, the field of study of the origin of developmental processes in all life forms.

**evolution:** Based on natural selection, a model developed by Darwin on the origin of diversity, and of species, among life forms.

**evolutionary psychology:** Field of study that views human traits as adaptations, subject to natural selection, or sexual selection; such universal tendencies interacting with culture and to shape specific behavior patterns in an individual.

**executive functions:** High-level mental processes subserved by the frontal lobes and their extensive connectivity with other brain regions, including planning, monitoring performance, inhibiting extraneous mental processes, and correcting errors.

**experiment:** Research method involving the random assignment of subjects to conditions, so that causal inferences are best made.

**extinction:** In psychology, form of operant conditioning in which response is followed by no stimulus, decreasing subsequent frequency of response. In evolution, the dying out of a species.

**extraversion:** One of the Big Five personality traits, linked to gregariousness, assertiveness, energy level, and tendencies toward action as opposed to reflection.

**family (pedigree) studies:** Method of determining heritability in behavior genetics research, through correlating degree of relatedness of family members with their risk of developing a certain condition or disorder; subject to the confound that more closely related individuals tend to share more interpersonal contact.

**formal operational stage of development:** Fourth stage of Piaget's model of cognitive development when youth become able to think abstractly and hypothetically; approximate ages 12 and up.

**frontal lobe:** Region of the cortex above the eyes and back toward the middle of the skull; larger in primates than other animals; linked to planning and emotional behavior.

**functional magnetic resonance imaging (fMRI):** Computer-assisted brain scanning device that uses powerful magnets to track oxygen levels

in various brain regions; has the ability to track where neural activity has recently occurred.

**gamma-amino butyric acid (GABA):** Major inhibitory neurotransmitter in the brain.

**gender:** Psychologically and culturally determined differences between males and females. *See also sex.*

**gene:** Unit of DNA on a given chromosome that codes for a particular protein.

**gene-environment correlation:** The linking of genetic influences on traits or behaviors with contextual influences; such association may be passive, whereby children's environments are correlated with the genes inherited from parents; active, whereby children seek environments consistent with their genetically mediated traits; or evocative, whereby children elicit responses from the environment that promote their genetically-mediated tendencies.

**gene-environment interaction:** Process whereby certain genotypes are maximally expressed only in specific environments; reveals that "main effects" of genes or environments are often not sufficient to explain individual differences in behavior.

**genotype:** Genetic make-up of organism; particular allelic combination underlying a given trait or behavior.

**glial cell:** Support cells to neurons in the brain; source of myelin.

**goodness of fit:** The matching of caregiving style to a child's temperament; evidence exists that more than temperament alone or caregiving alone, the fit is essential for optimal development.

**grey matter:** Brain areas with an accumulation of cell bodies; characterizes the cortical layers of the brain.

**hallucination:** Perception in the absence of a stimulus (e.g., hearing voices, seeing visions); symptom of psychosis.

**hemisphere:** One of the 2 major divisions of the brain; typically, the right is specialized for spatial functions and the left for language functions.

**heritability:** Proportion of variation in a trait or behavior attributable to genes, rather than environments.

**heterozygote superiority:** The adaptive success of an organism with 2 different alleles.

**hippocampus:** Brain structure found in temporal lobe essential for consolidation of long-term memories.

**hominids:** Species of the genus *Homo*, originating 2.5 million years ago; the only surviving species is our own species, *Homo sapiens*.

***Homo sapiens (Homo sapiens sapiens):*** Our species, originating approximately 150,000 years ago in Africa, and which has undergone extensive microevolution and cultural evolution since its inception, creating the modern human mind.

**humanism:** The perspective that the mind is linked to universal human processes and values, with the creation of narrative a key feature.

**implicit mental processes:** Mental processes occurring beneath conscious awareness, including attitudes, perception, and memory.

**inhibitory control:** The ability to suppress a previously-rewarded response, freeing the organism from constraints of the immediate environment.

**insecure attachment:** Individual difference in attachment security; insecure attachment comes in the form of avoidant attachment or ambivalent/resistant attachment; both believed to emerge from less-than responsive parenting during initial months of life.

**instinct:** In biological psychology, an inherited, fixed disposition toward behavior that does not require learning (or very little learning) to become fully formed. Although it is often assumed that humans have very few instincts



compared to most other species—because of human neural plasticity and learning capacity—evolutionary psychologists contend that humans actually have a host of instinctive, automatic mental modules.

**joint (shared) attention:** The following of a gaze or a “point” by child and parent; severely compromised in young children with autism.

**learning:** Acquisition of knowledge, behavior, skills, values, and the like, through classical or operant conditioning or modeling.

**levels of analysis:** The spanning of genes, gene products, neurons, and brains through the contextual influences on factors such as families, schools, neighborhoods, and cultures, leading to a constant interplay across such factors.

**magnetic resonance imaging (MRI; known as structural MRI):** Computer-assisted brain scanning in which strong magnetic fields provide anatomical pictures of soft tissue.

**manic-depressive illness:** *See bipolar disorder.*

**meme:** Hypothesized unit of cultural transmission; an idea or concept, spread via human communication, which may be subject to an analogue of natural selection.

**mental illness (models of mental illness):** Dysfunctional behavioral and emotional patterns yielding high levels of impairment and personal suffering; underlying models include statistical, social deviance, moral, ecological/impairment, medical, harmful dysfunction, and developmental psychopathology.

**mental synthesis:** Creation of never-before-seen mental images from previous perspectives or images; per Andrey Vyshedskiy, this is one of the few uniquely human capacities.

**mimetic skills:** Second phase of hominid development, per Merlin Donald, in which imitative skills formed the basis of learning and cultural transmission; associated with pre-humans.

**mind:** The total set of mental processes, linked intimately with brain functioning.

**modeling:** Form of social learning in which behavior is learned through observation of model, without reinforcement.

**module (mental):** Specific, innate program of the mind, instinctive, guiding cognitive or social processes. Modules are assumed to be units of mental processing that evolved in response to various selection pressures

**monoamine oxidase (MAO):** Enzyme inside the presynaptic axon terminal that may degrade neurotransmitters that are not inside vesicles.

**monoamine-oxidase inhibitor:** Monoamine-oxidase inhibitors are medications that break down MAO, leading to higher functional levels of the neurotransmitter.

**mood:** Affective state lasting longer than a discrete emotion, spanning minutes or hours.

**mutation:** Error in DNA sequence produced during copying; often harmful, but could lead to diversity that is adaptive.

**myelin:** Fatty sheath or coating around axons, greatly increasing conduction speed; formed from oligodendrocyte glial cells.

**mythic skills:** Third phase of hominid development, per Merlin Donald, in which spoken language became the main means of communication and cultural transmission; associated with modern humans.

**narrative:** A means of communication involving stories with sequences of events; narratives are a common means of transmitting culture.

**nativism (innatism):** Philosophical contention that the mind is guided by inborn processes and instincts.

**natural experiment:** A means of inferring causal relationships between events when full randomization is not possible but through natural events that juxtapose causal factors.

**natural selection:** The process through which evolution works: Mutations may lead to structures or traits producing fitness for reproduction, propagating such genes in future generations; hence, nature “selects” such genes.

**naturalism:** The perspective that the mind is the result of observable physical processes; directly juxtaposed to spirit-based views.

**nature versus nurture:** Outmoded juxtaposition of biological/genetic verses psychosocial influences on human development; such influences work in concert, rather than in opposition.

**negative reinforcement:** Form of operant conditioning in which response is followed by cessation of aversive stimulus, increasing subsequent frequency of response.

**neglectful parenting:** Style marked by low levels of both warmth/responsiveness and control/demands; associated with extremely poor cognitive and social outcomes.

**neural correlates of consciousness:** Brain regions, neural tracts, and neural processes that are associated with human self-awareness and sentience through brain imaging and other techniques.

**neuroethics:** Subfield at the conjunction of neuroscience and ethics dealing with brain mechanisms underlying human ethics and ethical implications of advances in neuroscience.

**neurogenesis:** Process of formation of neurons; most neurogenesis is prenatal in origin.

**neuron:** Specialized cell of the brain and nervous system; contains dendrites, cell body, and axons; conducts electrical current.

**neuroticism:** One of the Big Five personality traits, linked to pessimism, proneness to anxiety, stress reactivity, and becoming overwhelmed.

**neurotransmitter:** Chemical released from presynaptic axon terminal, traversing synaptic cleft to interact with postsynaptic receptor on a dendrite.

**non-shared (unique) environment:** The set of environmental factors that are not shared by children in the same family (e.g., peers; different parental styles with different children).

**norepinephrine:** Major neurotransmitter, related to appetite, sleep/wake cycles, impulse control, blood flow, and more.

**obsessive-compulsive disorder (OCD):** Mental disorder characterized by unwanted, ruminative thoughts (obsessions) and repetitive behaviors that attempt to undo the obsessions (compulsions).

**occipital lobe:** Region of the cortex at the back of the skull; linked particularly to vision.

**ontogeny:** The individual's developmental course from fertilized egg through maturity.

**openness to experience:** One of the Big Five personality traits, linked to appreciation of the arts, intellectual curiosity, and deeply-felt emotions.

**operant conditioning:** Form of learning whereby responses of the organism are followed by stimuli that either increase or decrease the subsequent probability of responding. The 4 types are positive reinforcement, punishment, negative reinforcement, and extinction.

**parietal lobe:** Region of the cortex from the top of the skull back toward the occipital lobe; linked to sensory functions and motor functions.

**perception:** The active processes involved in gaining access to constructs in the world through the sensory organs.

**permissive parenting:** Style marked by high levels of warmth/responsiveness but low levels of control/demands; associated generally with lowered academic outcomes.

**personality:** Overall structure of person's cognitive, social, and behavioral features; formed from combinations of core personality traits. *See Big Five personality traits.*

**phenotype:** Observable characteristics, traits, or behaviors of an organism; expression of genotype, epigenetic factors, and environments working in concert.

**phrenology:** Pseudoscience of the 19<sup>th</sup> century, contending that personality is shaped by brain anatomy, able to be “read” by patterns of bumps on the skull.

**phylogeny:** The domain of evolutionary processes, across species from early times on Earth until the present.

**plasticity:** Changes in brain function and structure related to experience; human brains have been naturally selected for a great amount of plasticity.

**positive illusory bias:** Everyday set of cognitive distortions in which normally functioning individuals underappraise personal weaknesses and overestimate personal abilities.

**positive reinforcement:** Form of operant conditioning in which response is followed by rewarding stimulus, increasing subsequent frequency of response.

**positron emission tomography (PET):** Method of imaging body or brain using radioactive substances to examine metabolism and activity.

**post-traumatic stress disorder (PTSD):** Mental disorder linked to overwhelming trauma, characterized by re-experiencing of the event, numbing, and physiological overreactivity.

**preoperational stage of development:** Second stage of Piaget's model of cognitive development where children come to represent and express experiences in language and symbolic thought; approximate 2–7 years of age.

**primates:** Class of species originating 80 million years ago, including monkeys, great apes, hominids, and humans.

**priming:** In cognitive psychology, the process in which an early stimulus influences responses to later stimuli.

**protective factor:** Variable that occurs in the presence of a risk factor to mitigate the risk or vulnerability, promoting resilience.

**pruning:** Selective loss of neurons that do not form viable synapses with other neurons; necessary for optimal brain development.

**psychoanalysis:** Form of therapy originated by Freud; intensive, daily treatment in which the patient discusses dreams and free associates, with the therapist interpreting the unconscious material.

**psychoanalytic/psychodynamic theory:** Theoretical models of the mind, derived from Freud (psychoanalytic) or successors (psychodynamic) emphasizing unconscious motivation, defense mechanisms, and parent-child conflict in explaining behavior.

**psychosis:** Syndrome involving hallucinations, delusions, agitation, thought disorder, loss of contact with reality.

**punishment:** Form of operant conditioning in which response is followed by aversive stimulus, decreasing subsequent frequency of response.

**qualia:** Subjective quality of a percept or experience; not believed to be reducible to brain chemistry or other naturalistic phenomena.

**reciprocal altruism:** Pattern of sharing resources without immediate benefit, in the hope of receiving subsequent “payback”; may be a core mechanism of human social bonds.

**reciprocal determinism:** Process of individual development whereby individual characteristics affect environment at the same time that environment affects individual.

**resilience:** The processes whereby an individual at high risk develops better than expected outcomes; often attributed to the presence of protective factors.

**reuptake:** Process of reabsorption of neurotransmitters into presynaptic regions; linked to transporter molecules.

**risk factor:** Variable that precedes a negative outcome and correlates with that outcome.

**schizophrenia:** Mental disorder involving positive or excess symptoms and negative or deficit symptoms; often extremely debilitating.

**secure attachment:** Pattern of child's being soothed by parental return after separation and using parent as secure base for exploration; believed to emerge from responsive parenting during initial months of life.

**self-esteem:** Inner sense of self-worth.

**self-organization:** The process whereby the internal organization of a system (like a brain, or a mind) increases in complexity without explicit external guidance.

**sensitive period:** Developmental "window" during which learning or development optimally takes place, although some learning may occur outside that window. *Contrast with* **critical period**.

**sensorimotor stage of development:** First stage of Piaget's model of cognitive development, in which infants and toddlers express intelligence through sensory and motor functions and abilities; occurring from birth to approximately 2 years of age.

**serotonin (5-HT):** Neurotransmitter involved in emotional responses, sleep, and many other functions.

**serotonin-selective reuptake inhibitors (SSRIs):** Used in the treatment of depression and anxiety, these medications block the serotonin transporter, allowing more serotonin in the synaptic cleft.

**sex:** Biological maleness or femaleness, determined by genes and prenatal hormonal influences.

**sexual selection:** Form of natural selection in which differential tasks or problems encountered by males versus females lead to differentiation of physical structures and behaviors. In intrasexual selection, males fight among themselves for access to females; in intersexual selection, females choose for preferred males.

**shared environment:** The set of environmental factors that are shared by children in the same family (e.g., parenting styles, income levels).

**social learning theory:** The modern combination of behaviorism, modeling, and additional cognitive processes, based on the conception that most human behavior is learned.

**sociobiology:** Field originated by E. O. Wilson in 1970s dealing with naturally selected bases of social behavior; forerunner of evolutionary psychology.

**socioemotional selectivity theory (SST):** Theoretical model that as people age, they develop foreshortened time horizons leading to the accentuation of positive emotions and the display of emotional wisdom.

**sociometric status:** The level of peer approval or disapproval one receives, based on nominations of being liked or disliked from the peer group. Children may be popular, average, neglected, rejected, or controversial where they are liked by some and disliked by others.

**stigma:** Internal mark of shame, related to membership in a devalued social group; composed of stereotypes, prejudice, and discrimination.



**stimulant medications:** Used in the treatment of ADHD, these medications block the reuptake of dopamine and norepinephrine, increasing attentional focus and enhancing inhibitory control.

**strange situation:** Assessment method for appraising an infant's attachment security; involves caregiver and stranger entering and exiting room with infant.

**synaptogenesis:** Process of formation of synaptic connections between and among neurons; driven by genetic programs and experience; reaches a peak in the first years of life.

**synapse:** Junction between neurons; composed of preynaptic axon terminal, synaptic cleft (space in between), and postsynaptic dendritic spines. Neurotransmitters cross the cleft to communicate between neurons.

**temperament:** Early appearing, biologically determined emotional and behavioral response tendencies; aspects of temperament form the basis of later personality.

**temporal lobe:** Region of the cortex above the ear, or temple; linked to hearing, language, and memory.

**tertiary regions (association areas):** Portions of cortex that do not receive direct sensory input but rather make abstract connections between concepts; these regions are larger in humans than other primates.

**thalamus:** Subcortical region; “relay station” of sensory inputs to the cortex.

**theoretic skills:** Fourth phase of hominid development, per Merlin Donald, in which written language became the main means of communication and cultural transmission; associated with extremely modern humans.

**theory of mind:** Mental module assumed to come “online” between 3–5 years of age, through which children come to the understanding that other humans have perspectives different from their own.

**thought disorder (formal):** Disturbance in the structure and form of thinking and speech processes; symptom of psychosis and schizophrenia.

**toolkit gene:** Gene that regulates the actions of other genes; also called “master gene.”

**tract:** Nerve pathway, composed of axons traversing different brain regions.

**transporter:** Molecule that facilitates reuptake of neurotransmitter back into presynaptic region.

**Turing test:** “Test” suggested by mathematician Alan Turing for appraising the success of artificial intelligence, as measured by whether a conversation with a computer versus a conversation with a human would be indistinguishable.

**twin studies:** Method of inferring heritability in behavior genetics research, through determining the difference in concordance rates of a trait or disorder between identical versus fraternal twins.

**unconscious mental processes:** Cognitive and emotional activities that transpire without awareness. In cognitive psychology, unconscious processes are often termed implicit (unaware) attitudes, perceptions, and memory; in psychoanalytic theory, the unconscious is a conflict-ridden terrain at the intersection of the id, ego, and superego.

**vesicles:** Storage areas in presynaptic axon terminals, protecting neurotransmitters from enzymatic degradation.

**white matter:** Axonal regions of neurons; appear white because of myelination; source of connectivity of brain.

## Biographical Notes

These are very brief sketches of a few key individuals, throughout history, who have contributed to our knowledge of the origins of the human mind. The large numbers of contemporary neuroscientists, evolutionary biologists, evolutionary psychologists, and other scientists who are interested in and contributing to this topic cannot be noted here.

**Bowlby, John** (1907–1990): British psychiatrist who brought attachment theory to scientific and public attention. His early work on institutionalized infants, delinquency, and poor childrearing practices culminated, in mid- and late career, with seminal work on the species-wide importance of attachment, drawing from a diversity of fields: evolution, ethology, developmental psychology, and cognitive science. His thinking on attachment integrated evolutionary theory, psychodynamic theory, and developmental studies. His major 3-volume set on attachment theory includes *Attachment* (1969), *Separation: Anxiety and Anger* (1972), and *Loss: Sadness and Depression* (1980).

**Chomsky, Noam** (1928–): American linguist, philosopher, cognitive scientist, and political activist/dissident; Chomsky contributed greatly to the cognitive revolution and to “innatist” views of the human mind in his early psycholinguistic work, during the 1950s, in which he critiqued B. F. Skinner’s operant conditioning account of language development and posited a fixed, innate, universal grammar underlying all human languages. Over the years he has become known as much for his radical political views as his work in cognitive science and linguistics, though he claims that the endeavors are entirely separate.

**Darwin, Charles** (1809–1882): One of the scientific giants in all of history, he is credited as the co-originator of the theory of evolution by natural selection. Having abandoned medical and clerical studies, this English naturalist embarked upon a 5-year, around-the-world journey on the HMS *Beagle* from 1831–1836, spending much of his time on land to make detailed observations of geological formations and a variety of species of

life. After years of deliberation, and spurred by Wallace's formulation of natural selection, Darwin published *On the Origin of Species* in 1859, which became a changing point in the history of humanity's views of life, and itself as a species. Subsequent books included *The Descent of Man and Selection in Relation to Sex* (1871) and *The Expression of the Emotions in Man and Animals* (1872).

**Dawkins, Richard** (b. 1941): British evolutionary biologist, who has received much acclaims for his popular science writing, he wrote *The Selfish Gene* in 1976, arguing that genes are the unit of natural selection; he also introduced the concept of memes in this work. His book, *The Blind Watchmaker* in 1982, is a strong call to resist any sort of intelligent design as an explanation for the complexity of life. *The God Delusion* (2006) lays out his strongest arguments as an atheist and as a critic of creationism.

**Ekman, Paul** (b. 1934): American psychologist most recognized for his cross-cultural investigations of the universality of emotional displays and the universality of recognition of basic emotions. His work went against the grain of the cultural determinists of the mid-20<sup>th</sup> century. He has done extensive work on facial displays of emotion and the detection of lies. Among his books are *Emotions Revealed* (2003) and *Telling Lies* (2001).

**Freud, Sigmund** (1856–1939): Austrian psychiatrist and founder of psychoanalytic theory and psychoanalysis as an intensive form of psychotherapy. After studying neurology and advocating physical bases of mental disorders, Freud began to develop a completely psychological theory of normal and atypical development, based heavily on unconscious mental processes, defense mechanisms, symbolic meaning of symptoms, and inevitable conflict between individuals and society. Psychoanalytic theory was further developed by many followers; less doctrinaire versions are known as psychodynamic formulations. His work changed the way modern societies think about the mind, even though many psychoanalytic principles and concepts have not withstood empirical scrutiny.

**Hippocrates** (c. 460 B.C.E.–c. 375 B.C.E.): Ancient Athenian physician, known as the father of medicine, Hippocrates integrated philosophy and medicine and discredited the predominant view of the time that supernatural

forces were the dominant contributors to illness. He therefore presented a completely naturalistic view of human health and illness, based on the 4 “humors”—yellow bile, black bile, blood, phlegm—and their relative balance in the body. He promoted the view that the practice of medicine should incorporate discipline, humility, professionalism, and ethics. His observations of physical and mental disorders are remarkably modern in their detail.

**Mendel, Gregor** (1822–1884): European priest and scientist, known as the father of modern genetics, he worked out the laws of inheritance from his investigations on pea plants in his monastery’s garden. His findings were obscure until they were rediscovered after his death; in the 20<sup>th</sup> century, a major synthesis of Darwinian evolution and Mendelian genetics took place, setting the stage for the resurgence of modern evolutionary theory.

**Pavlov, Ivan** (1849–1936): Russian physiologist, physician, and psychologist, he discovered the essential mechanisms of classical conditioning. He won the Nobel Prize in 1904 for his work on the physiology of the digestive system; his psychological work originated from his having noticed that dogs began to salivate prior to presentation of food, at the sound of a signal. He was interested in the implications of the “conditioned reflex” for mental disorder.

**Piaget, Jean** (1896–1980): Swiss natural scientist and philosopher; originator of “genetic epistemology,” the study of the development of knowledge of the world. Many of his theoretical ideas emanated from careful observation of his 3 children. He posited a complex theory of cognitive development, which emerges in stages throughout childhood as the result of children’s active manipulation of the world. Each stage represents a new level of complexity. His books include *The Child’s Conception of the World* (1928), *The Moral Judgment of the Child* (1932), *The Origins of Intelligence in Children* (1952), and *The Child’s Construction of Reality* (1955).

**Skinner, B. F.** (1904–1990): American psychologist self-identified as a radical behaviorist, who denied any meditational properties of the mind, instead concentrating on schedules of reinforcement in relation to the learning and performance of behavior. He invented the operant conditioning chamber as a graduate student and performed considerable research on the

power of such reinforcement schedules (related to operant conditioning). His book, *Verbal Behavior* (1957), served as the stimulus for Noam Chomsky's critique related to innate language structures in the human mind. Other books include *Walden Two* (1948) and *Beyond Freedom and Dignity* (1971).

**Tolman, Edward Chace** (1886–1959): American psychologist, who transcended the behaviorist and social learning traditions of mid-20<sup>th</sup>-century behavioral science to posit that even rats running mazes had cognitive maps and that learning could occur without reinforcement. He was a forerunner of the cognitive revolution of the 1950s and beyond. His major contributions came in journal articles and in his book, *Purposive Behavior in Animals and Men* (1932). A professor at the University of California, Berkeley, he refused to sign the state's loyalty oath during the McCarthy era, and his lawsuit led to the overturning of the oath.

**Wilson, E. O.** (b. 1929): American naturalist and biologist who originated the field of sociobiology—now known as evolutionary psychology. A world expert on such social species as ants, Wilson has also been an ardent advocate of preserving all species on Earth. He is a secular humanist who contends that religious activity has been naturally selected among humans. A Pulitzer-Prize winning author, he has written many books, including *Sociobiology* (1975), *On Human Nature* (1979), *The Ants* (1990), *The Diversity of Life* (1992), *Naturalist* (1994), and *Consilience* (1998)

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